# THE ECONOMICS OF CONTRACTING

A Treatise for Contractors, Engineers, Superintendents and Foremen Engaged in Engineering Contracting Work

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*To those Pioneer Contractors, who by their labors and integrity have placed the profession of contracting on its present high plane, this book is dedicated by the author.*

# PREFACE

MORE than twenty years ago, when the author started out in the engineering contracting field, much had been written on engineering subjects, but little on contracting. When questions were asked as to different phases of conducting a contract, the reply was, that all of these things must be learned by experience, and it was frequently stated that "Contractors are born not made."

Those were the days when contracting was considered purely a business, but within the past two decades the execution of construction contracts has become so specialized that today it must be considered as a profession, requiring organized knowledge.

A profession is the result of a study of its principles and history, using the experience of others as a basis for the student and beginner. It is with this idea in view that this treatise has been given to the profession. The older contractors may find in it some thoughts and ideas that may be useful, and this book may assist them in realizing that some wastes still exist in their own business, and a few details that have not been mastered.

The young man should not expect to become an experienced contractor by a close study of this treatise, but he can learn to do some things, and how to guard against both loss of time and money in eliminating mistakes made by others.

The information given is based entirely on the author's own experience and on knowledge gleaned from others, in many cases from men younger rather than older than himself. Only too frequently the experience bought was from failure rather than success and was bitterly gained, and it is with the hope that these failures may be averted by others, that this book is written.

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# THE ECONOMICS OF CONTRACTING

## CHAPTER I.

### CONTRACTING AS A PROFESSION.

CONTRACTING is often spoken of simply as a business, and years ago it was a business just as storekeeping is, but conditions have changed in the last twenty-five years, so that today it is considered a profession. A business is a mercantile pursuit of general character, which any man of sufficient experience in traffic can enter without special training. A profession calls for expert knowledge and previous training.

Several decades ago almost any man could engage in the construction business with fair chances of success, and there are a number of these early contractors, who now stand at the head of their profession; but changes have taken place, and a man entering engineering contracting today must have had some previous training.

At present such preparation cannot be obtained at any of our leading universities. Engineering is taught at many institutions, but engineering contracting has not yet been put on this basis. It is a disputed question, not only among educators, but among engineers and contractors, as to whether or not contracting can be taught in our colleges. The author believes that courses can be mapped out which would be as useful to a man proposing to enter contracting as those at present followed by the student of engineering. A course in college and an engineering degree do not make an engineer, as we all know. But such a course with five or ten years of practical experience has produced some of our ablest

engineers. A good course in contracting, followed by some practical training, will make a successful contractor.

Some claim that the successful contractor is born and not made. There can be little doubt that there will always be some men who, with only a few years of general business experience, and without previous training or education, will make successful contractors, just as there are a number of eminent engineers who are not college graduates. Pointing out these examples does not establish the rule. They are rather the exceptions to the rule.

A man's natural ability will always count in the race for success. Those born with an aptitude for handling men, and for the management of large enterprises, will achieve success quicker or in a greater measure than those who have no such talent. Yet these men sometimes do not realize that they, too, can learn from others. Learning early in life to depend upon themselves, they refuse to be benefited by the thought and labors of others, and treat with disdain the suggestions and writings of those who offer advice.

The best balanced man is one who, in spite of the realization of the possession of certain ability, knows that he has much to learn, and has the patience to take ideas and thoughts of others to weave in with his own. A man must never let his judgment be swayed by his prejudices. He should be willing to recognize and acknowledge beneficial ideas and suggestions from whatever source they may come.

Some say that they have no use for certain printed information, as they cannot put faith in the author, or they may dislike him. This is wrong. A man writes either from his own experience or from that of others. An author writing from the experience of others will give much valuable information, although he may be classed as a compiler, since he gleans the ideas of many others and presents them to the reader. The compiler is likely to be weak in deductions from the information he compiles, due to inexperience in practical matters. He may, however, possess the advantage of familiarity with many different methods. His writings and work are sure to be of value, except to the most narrow and obstinate.

The original writer, recording his own experience, will always be considered the author who adds to the world's knowledge. Such

eminently successful and men whose success has been indifferent. The former will tell of their successes and how they obtained their results, ignoring, as a rule, the difficulties they were obliged to overcome, while the latter will make much of their failures and thus warn others against the same mistakes. Mr. Carnegie's writings are valuable from a business standpoint, but a record of the experiences of Mr. Bowers in the hydraulic dredging business, telling of his failures and successes, would add much to the literature on engineering contracting.

Without colleges and with only scanty literature on the subject, how is a man to fit himself for the contracting profession? There are numerous ways open. Many men are taking courses in engineering colleges and after graduating are associating themselves with contractors, first as their engineers, then as superintendents and general managers, after which they feel that they have gained experience enough to start in for themselves.

Others obtain a first-class English education, then graduate at some business college, after which they go into the accounting department of some large contracting concern. Such a man usually makes a success, for he is accustomed to deal with figures, and will not let sentiment sway his judgment. Several of the most successful contractors started in this manner.

Many young men cannot afford either the time or money to obtain more than an elementary education. Some have started in engineering corps and have obtained an insight into contracting and engineering in that manner. Others have started as timekeepers or bookkeepers for contractors. Still others have started out as laborers or teamsters, become foremen, then superintendents or general managers and at last contractors. It is difficult to say which is the best way. There have been failures and successes in all these methods. The man trained in the office end will frequently lack the outside experience, and vice versa.

Many active young men who become clerks in stores and with large mercantile concerns, would find it to their advantage to take up construction work, especially as foremen. Good foremen are always in demand, and can command wages for the entire year. Such young men make meagre salaries as clerks and their promotion is slow, while as foremen they would in many cases make larger salaries at the start, and their chance of promotion with

*Partnerships.*

It can be set down almost as a rule that a man who has not fitted himself in one way or another for the profession, cannot make a success of contracting. Having prepared himself for contracting by his previous experience, the question arises whether he shall start out, by himself, with a partner, or with an incorporated company. Two influences tend to cause a man starting into business for himself to associate with a partner or partners. One is the lack of capital. Every one feels that to have his capital doubled or trebled gives a chance of earning many times more than he could earn with his own money. This is generally true in any business, and is especially so in contracting. In many kinds of construction work, doubling one's capital when it is comparatively small, makes it possible to take contracts of considerable magnitude under more favorable conditions. The author has known a contract involving more than a hundred thousand dollars to be handled with a capital of about four thousand, yet with only two thousand dollars, not more than one-quarter of this work could have been done.

The second reason for having partners is that one feels that in addition to the capital, the partner brings his advice and labor. Almost any one likes to have an associate with whom he can consult.

In spite of these facts, most men are better off in contracting without partners. It is true that with limited capital one may be obliged to confine his work to small jobs and take subcontracts, but the only injury he may sustain will be to his pride. He will be making his way cautiously, but all the profits will be his, and he will be laying the foundation for a larger business in the future. Many men have disdained the small things as young men, wanting only large undertakings, and have thus overstepped, and finished their careers executing small contracts or in the employ of others.

A man by himself knows that mistakes made or money lost are due to his mismanagement, and such things are rectified much more quickly than when there are partners, where one may lay the blame on the other. The contractor, depending entirely on himself, will also give his work much closer attention than when there are

only be the general manager, and plan out the work, but he must do his own buying, act as paymaster, oversee the bookkeeping, and make up estimates and bids. Some of these things may be done by employees, but they have to be done under the contractor's supervision. In the author's opinion, the best experience a contractor can have when he begins business is to work without partners.

If one decides to take a partner, the question of selection arises. Each man must decide such a question for himself, but there are several phases which should always be considered in making a selection. Some years ago a successful contractor said to the writer, "Never go into partnership at contracting with a man unless you have known him five years." This, no doubt, is good advice, but there are many cases where partnerships have been unsuccessful when the partners were well acquainted. On the other hand, men have been brought together through advertisements and other means, and although previously strangers, have been very successful as partners. A high regard for an old friend of a kindly disposition may cause one to overlook qualities which are objectionable in a business associate. A partnership should not be formed on sentiment, but in a cold business manner, and should be based on specific conditions.

There should always be a written agreement between partners, stating definitely how the partnership may be terminated. It should not be stipulated that a partner's interest in the firm cannot be sold to a third party without first advising the other partners that it is for sale, and they shall have the preference in buying, unless the minimum purchase price is set forth. Neither should a clause be inserted, saying that if the interest is first offered for purchase to an outsider, it is forfeited to the other partners. An agreement naming either a minimum or a maximum purchase price should be renewed every year and a new price set. It is nearly always advisable to have partnership agreements run for a given term of years or for certain jobs.

Each partner is liable for the entire indebtedness of the firm, and ignorance of the firm's affairs will not excuse him. Creditors can recover from any one member of the firm. Each partner can only claim his proportionate share of the profits, but each member of the firm can use his own judgment in selling any or all

other acts which all the partners could do, and their only redress is a civil suit. The firm is also bound by any promises made by each member.

For these and other reasons it is never well to take as a partner a man who is addicted to gambling or excessive drinking. Such a warning may seem useless, but some contractors have done this to their sorrow.

If partners are dependent upon their business from the start for their living, it is advisable to pay each one a salary. At first it need not be large, especially if the original capital is small. A salary is preferable, as then one partner will not draw more than the others, nor will there be a desire to use the firm's money for personal needs. A drawing account may be considered a loan from the firm, which may have to be paid back, while a salary does not have to be paid back even in case of failure.

In any mercantile business it is a comparatively easy matter for two partners to divide up the work to be done between them, but in contracting this is different. There cannot be two bosses on construction work. If so, things are sure to go wrong. Two or three men can consult together as to best methods and details of the work, but if two or more people go on the outside and give instructions, the likelihood is that many things will be done wrong and at an increased cost. Consequently, it is generally best for one partner to be in charge of the outside work. He may make mistakes, but if he is a man who gets results, it will be much better than to have one or more interfering with him. One of the most successful contractors in the United States learned this lesson early, and when he goes into partnership with any one on a contract, he makes an agreement with his partner that he is to have entire charge. His superintendents and general manager have more authority on the work than his partners, unless he places a partner in charge of some particular work. If one partner is accustomed to outside work and the other to office work, the duties can be easily divided. One partner supervises the forces at work and the other the bookkeeping, timekeeping, finances, purchasing and other office details. Should both partners be outside men, it is desirable to obtain several contracts, and for each partner to superintend certain jobs with the help of an office manager, consulting at times with the other. If the business is large, and there are more than two members of the firm, one can devote most of his time to bid-

ding, estimating, obtaining new contracts and keeping in touch with those who will have work to let. This partner can do most of the traveling and arrange for bonds, loans and similar things. Each member of the firm should be selected to do the work for which he is best fitted.

### *Corporations.*

When two or more men associate themselves together in the contracting business, it is best to form an incorporated company. latter are: that taxes must be paid on the capital invested, as well as latter are that taxes must be paid on the capital invested, as well as on personal property and real estate; that the capital, set forth as being paid in, must be paid in money or its equivalent, while in a firm there need not be a definite sum of money paid in, the amount being left entirely to an agreement between the partners. Again, credit is extended to the corporation only on the amount of the capital stock, while the credit of a firm is to the extent of the combined resources of all the partners. As a rule, greater publicity is given to the business of a corporation than that of a firm.

These disadvantages are offset by many advantages. In a corporation a stockholder is not liable for any debts of the firm, and, in fact, if the stock is non-assessable, he pays into the corporation only the price of his stock. Then, unless he does some act that is illegal, he cannot be held for any other money. In a corporation a man holding stock has no active part in the management unless he is an officer or director. He has a vote for every recorded share of stock he owns in electing directors and on business matters brought up at the stockholders' meetings.

The by-laws of the corporation are adopted when the company is formed, and are amended as experience shows the necessity. Upon these by-laws may hinge the entire success of a company's business. If they are very general, the different officers may interfere with one another, so that the organization is damaged by discord. Therefore the by-laws should clearly set forth the powers of the directors and prescribe the duties of each officer.

In a corporation neither a stockholder nor an officer should be allowed to draw money from the treasury. All the officers should be paid reasonable salaries for the work they do, and stockholders should be paid only dividends declared on the stock. If other

money is paid to them, both the stockholders and the officials who may sanction the payment are personally responsible for such money. The by-laws should set forth how dividends shall be declared, and provide for a surplus working capital. All of these factors lead to smooth management and a strong organization.

Properly organized corporations are in a position to carry on several contracts at one time and most of the leading contracting companies are incorporated. A company of this nature should be able to remain in business for years, as the death or withdrawal of a leading man need not affect the corporation. The value of the stock easily permits of its being bought or sold and as a matter of fact large blocks of stock often change hands.

Corporations are better fitted to deal with many of the industrial problems of the day than firms of individuals. It is likewise true that they are better able to cope with such problems as responsibility for accidents to workmen, bonds for contracts, purchasing and maintaining large plants, and other features which are part and parcel of the contracting business.

### *Sub-Contracting.*

Almost every engineering contract that is let contains a clause reading somewhat like this: *"It is agreed that this work, as a whole or in part, shall not be sublet without the written permission of the engineer."*

Notwithstanding these clauses much construction work is sublet and protest is seldom made by the engineer or his employer. The author's experience, covering many years, is, that although much work is sublet, especially in some sections of the country, it is the exception when either written or verbal permission is obtained. Then why keep such a provision in contracts? This old clause, entirely prohibiting sub-contracting, is probably retained as a survival of the old idea, which allows the engineer to control the situation.

A better plan would be to draw up clauses to govern and control sub-contracting rather than use the one quoted. Naturally, the engineer and his employer are interested in those who are to do their work, and it would seem wise to state that a sub-contract shall not be valid after it is executed, until countersigned by the engineer. Should this procedure not be legal, it could be set forth

that the engineer is to approve of the sub-contractor before the work is sublet to the latter. Any other conditions that are to be met should also be set forth.

It is an antiquated and erroneous idea that sub-contracting should not be permitted. Experience is proving conclusively that sub-contracting is of great benefit in carrying on construction work.

There are objections to sub-contracting as there is danger of carrying it to extremes. For instance, a general contractor agrees to do the grading for a new railroad for 70 cents per cubic yard for solid rock, 40 cents per cubic yard for loose rock and 22 cents per cubic yard for earth. This contractor divides his work into two sections and relets at 60 cents, 34 cents and 18 cents per cubic yard. These sub-contractors in turn let out all or part of this grading at 57 cents, 31 cents and 16 cents per cubic yard. The last sub-contractors do the work and make approximately 15 per cent profit. Thus the work is relet three times and the railroad company pays out profits in the aggregate amounting to about 2½ cents per cubic yard on solid rock, 12½ cents per cubic yard on loose rock and 8½ cents per cubic yard on earth. Under these conditions a profit of about 30 per cent is made on both classes of rock and about 40 per cent on the earth excavation. The author has known this state of affairs to happen.

Such abuses can and should be prevented, unless the funds for building the railroad and structures are furnished by the contractors.

*Advantages of Sub-Contracting.*

An advantageous condition of doing work by the sub-contracting method is shown in building construction. A general contractor takes the entire contract for a structure and sublets the foundation work to one contractor, the iron work to another, the fireproofing to a third contractor, the plumbing under a separate contract, the painting to a painter, and so on through a long list, leaving the general work to be done by his own forces. Sub-contracts for the materials to be used are always made. Each sub-contractor is more or less a specialist in his line, and has in his employ skilled laborers, causing the work not only to be done better, but as a rule cheaper. The general contractor in

making his bid has taken into consideration prices submitted by these specializing contractors.

This method of doing work is to be commended even when it is not necessary to have specialists, particularly when the job is an extensive one. If a contractor, building a 100 miles of railroad, were to execute the entire contract with his own forces, a number of outfits, costing many thousands of dollars, would be necessary, and a large amount of capital would be required for carrying on the work. There might be a number of camps from which teams would be worked, several steam shovel outfits, camps for masonry work, for cutting ties and timber, and others for bridges. For each force worked, there would have to be a superintendent, and a general manager would have to be employed to look after these superintendents. All of these men would be working on salaries, and some of them would certainly do indifferent work.

If the job is divided into small sections, according to the class of work to be done, all of the above objections are overcome. Instead of one man requiring an excessively large outfit and capital, these items are divided among a number. Over each section or kind of work a man is in charge who is vitally interested, his salary (his profits) depending entirely upon his own exertions and judgment. His capital (past earnings) is invested in his outfit. He will see that horses, machinery and tools are well cared for, and he knows that in order to make a living and advance in his profession, his work must be handled so that it will net a profit. In making a profit he assures a profit to the general contractor.

Under this method a sub-contractor becomes a foreman or superintendent for the general contractor, but instead of being paid a salary he is paid unit prices stipulated in his contract. He furnishes plant and money to carry on the work and under most circumstances earns much more than he could on a salary basis.

*Standing of Sub-Contractors.*

The owning company only knows the sub-contractor through the general contractor, but their interests should be identical, the latter looking after the interests of the former and helping

him in every way possible. Money can be advanced by the general contractor to the sub-contractor on work done, but not estimated by the engineer, and such other assistance given that a sub-contractor who is honest and industrious can do a large amount of work with but little capital and plant. The author when in charge of work has taken good foremen and furnished them with an outfit and money and made successful sub-contractors of them, so that within a few years they were able to undertake contracts without assistance. A contracting firm with a large following of sub-contractors can undertake larger and more contracts than a firm as strong financially, but doing all work with their own forces. Furthermore, by means of sub-contracts a very large undertaking can be finished on time, if handled by a contracting company accustomed to sub-contracting.

If proper supervision is given to sub-contractors, a bond from them is not necessary, but is rather a hindrance, for if it should become necessary to take the work away from them, a bond would complicate matters. The general contractor's protection should be in his knowledge of the sub-contractor, the outfit and plant owned by the latter, and in the form of contract used with him. Some general contractors use the same form of contract they have signed with the company from whom they have obtained the work. In many cases such a form of contract may not work harm, but the responsibility for the faithful completion of the work rests with the general contractor and his contract with the sub-contractor should be such as to make him complete master of the situation.

A hazardous and difficult piece of work should seldom be sublet. If the margin of profit should be small, the work had better be done with the forces of the general contractor, rather than risk it with a sub-contractor, who might fail on it, and leave the job in such condition as to make the work much more expensive. Such work can often be done to great advantage by the general contractor and a sub-contractor joining forces.

These are some of the reasons why sub-contracting is a common practice, in spite of provisions in contracts prohibiting it. Contractors understand this, and those with long and broad experience are the ones who favor sub-contracting and do much of their work by means of it. The principle of sub-contracting, stated in a few words, is that the man who superintends the work

has his own money invested in it and it is to his interest to make sure of a profit on the work.

### *Public Contracts.*

Contracts with towns and cities, counties, states and the national government are known as public contracts and differ much from private contracts, those with individual firms and corporations, and the conditions under which they must be performed and fulfilled vary much from private contracts.

On private work a contractor doing work for a responsible corporation or other party, generally receives his monthly payments promptly. This allows a contractor, carrying on extensive work, to do so with comparatively little cash capital. On public contracts, payments may be prompt, but in many instances monthly payments are often delayed, or held up, and the contractor must have ample cash in hand to carry him over these periods, otherwise arrangements must be made for borrowing the necessary funds.

Payments on public contracts may be held up for many reasons: Lack of available funds, that is, the season's or year's work exceeding the amount of the yearly appropriation, under which conditions the contractor will be required to carry the value of the extra work done, until new funds become available. Payments may also be delayed by taxpayers' suits, injunctions, or by various officials refusing, for one reason or another, to certify to estimates, or by the postponement of meetings of official boards to pass upon estimates or plans.

Another feature of payments for work done on public contracts is that when the cost of the work exceeds the appropriation, the contractor cannot recover for the amount above the appropriation. If payments are refused and the contractor sues, the courts will not allow him to recover, neither is it legal to pay the contractor by new appropriations. The latter method is adopted at times, but if any taxpayer objects the whole procedure can be stopped. Courts hold that contractors must inform themselves as to the amount of the appropriation and the provisions of the enabling acts governing the work. Likewise, should the officials having in charge the spending of funds for construction, either divert the money to other uses or actually misappropriate the

funds, the contractor, should there be a shortage, cannot recover the amount misspent. To illustrate: If an appropriation for paving a street is $200,000 and a contractor bids $190,000 for the work, which with engineering expenses of $10,000 would make up the $200,000, should the engineer in charge use $20,000 of this fund for building a sewer, the contractor can only receive $170,000 for his pavement, as the court ruling is that the contractor must keep himself posted as to the spending of such appropriations.

Suit cannot be brought against the national government, but claims of any nature can be presented to the Court of Claims. Contractors seldom avail themselves of this privilege, as their experience is that the ruling of the government engineers is generally equitable, and it is almost useless to dispute over construction work into the Court of Claims.

These remarks show the necessity of the contractor keeping himself posted on every feature of a public contract and the necessity of large cash capital. In bidding on work he should include an allowance for interest on this capital, in his prices.

On private contracts, when difficulties are encountered, it is possible for the engineer to change either the plans or specifications so as to assist the contractor in his work, but on a public contract such changes are not legal. The engineer has no discretionary powers, as he must conform to the specifications and plans, only making such changes as provided for in the specifications. This also holds true of allowances. The engineer cannot make allowances in payment for unforeseen conditions. He can only make payments for the classes of work listed in the contract and at the contract prices. Neither is it possible for the engineer to make other classifications of work than those provided for in the specifications and plans. On many classes of work, such as excavation and masonry, the classification is important, and a strict carrying out of the contract often means a considerable money loss to the contractor.

A low price on a public contract may not only mean ruin for the contractor but also a great money loss to the contractor's sureties. On a private contract it is often possible for the contractor, if he has a losing job, to throw it up without any great trouble, but this is not so on a public contract. If he throws up a contract, his sureties are responsible, and if he continues his

contract until he is bankrupt his sureties must complete the work. This is true for all city or state contracts and especially so on work for the national government. Public officials have not the power to release a contractor from a losing contract. Many a man has ruined himself financially by naming such low prices on government work, that the bonding companies refused to become his surety, making it necessary either to forfeit his bidding bond or certified check, or ask personal friends to become his sureties. Then he and his friends have been compelled to finish the work at a great money loss.

A contractor accustomed to doing work for private corporations must bear in mind that on public contracts any part of the work may take on its worst features, according to the plans and specifications, and that these provisions will be as unchangeable as the laws of the Medes and Persians. For these reasons public work must not be underbid. As compared to work done under private contract, it is nearly always more expensive.

### *Payments on Contracts.*

Most construction contracts for engineering work, especially for railroads and other large projects, provide for monthly payments during the progress of the work. It is customary for the engineer to make an approximate estimate about the first of each month, and for the owner to pay to the contractor, on or about the 15th of the month, the amount of this estimate, less the retained percentage held for the faithful completion of the job. As a general rule 10 per cent of the monthly estimate is retained, although some contracts provide for holding back 15 per cent, and at times as much as 25 per cent.

Under this arrangement, the contractor can pay his labor, material bills and other obligations about the 20th of each month. Upon this basis the contracting business has made rapid strides in this country, and the American contractor has become the greatest construction engineer of the world. Men of ability have been able to engage in the contracting business and make successes in spite of the fact that they had very little capital.

This was possible because the contractor who had an outfit of tools and horses, with enough money to pay small bills, freight and such items for a month, could undertake an extensive

contract and inasmuch as he received ninety per cent of the money earned each month, and paid only his labor and material bills from this money, he could finance his job, if his profit was ten per cent or more. The contract thus became the contractor's largest asset.

Numerous examples of poor men entering the contract business and making fortunes can be found in every section of the country. One of the most successful contractors of the south today was a mason and tile setter working for years on day's wages. He managed to secure a railroad contract, and has been successful beyond his expectation. A prominent contractor of the middle west began his life's work by driving a team on a railroad grade. He saved enough money to buy two horses, which he hired to his employer. He was soon able to buy others and within a year had enough teams to undertake a contract of his own. Since then he has made more than half a million dollars in a single year. Another contractor of national reputation began as a timekeeper for a western contractor on a small salary. Beginning without capital, his success has been phenomenal. Other examples could be given from the author's acquaintance, but this should suffice.

Those to some extent were the halcyon days of contracting, but contractors can make money in this day as well as in the past. It is true that conditions have changed, and the contractor has been obliged to change his methods to keep up with the times. In spite of this he is compelled to sign and work under the old form of contract.

Workmen in nearly every section of the country demand to be paid twice a month, and in some cases every week. In some states the law compels such payments. The pay roll cannot be earned before it is to be paid, nor can the contractor be more than a day or two behind in meeting his pay roll. Therefore, considerable ready cash must be in hand to start a job, in order to pay the labor for a period of four to six weeks. On some contracts this runs into many thousands of dollars.

Fifteen or twenty years ago little machinery was used on construction work. Wheeled scrapers were not introduced until after the civil war, and were not in general use until the seventies. In the early part of the nineties, the city of Boston took bids for building a reservoir on which it was necessary to use a steam shovel. Proposals were received from twenty-nine leading contract-

ing firms of the country, and of these only one had previously operated a steam shovel. This alone shows how little machinery was used twenty years ago.

Contractors today are among the largest purchasers of machinery. A few years ago one contractor bought from one of the leading steam shovel manufacturers nineteen steam shovels within a year. During the past year one company sold a contractor sixteen dinkeys at one time. During the past two years contractors on the new Catskill aqueduct have undertaken work on which the value of the plant has varied from a quarter of a million dollars to nearly a million dollars. This means that the contractor must have ample capital in order to undertake a large contract. A large monthly expenditure for repair parts, fuel and supplies is also necessary in the operation of this machinery.

It follows that a contractor having so much money invested in his work must obtain sufficient funds to cover interest on his investment, depreciation on his machinery and other heavy expenditures. Competition is also eliminated to some extent, since the contractor with less means cannot obtain the capital to undertake work requiring much plant.

What is the solution? Machinery is necessary today on construction work for one of two reasons: either to reduce the cost of the work; or by rapid work to save time during construction, though this may prove more expensive. Machinery can be obtained without a large amount of ready cash, by either rental, which is paid monthly, or a lease-sale agreement, whereby a cash payment is made, and the rest is paid monthly or quarterly. In this manner the plant can be placed on a job by a man of limited means, if his credit is good.

The pay roll can be taken care of by the owner making payments on work done at more frequent intervals than once a month. Then labor can receive its own wages from its work as it did when pay day came but once a month. Naturally, this means more work for the engineer in charge, and it may cost the owner a little more money, but the saving in prices bid, and the advantage of obtaining ambitious men who are working hard to build up their business, more than compensates for this.

The time has arrived when contract forms should be revised, and contractors should receive semi-monthly or weekly payments, instead of monthly payments. To do this would result in restoring

the contract business to its former basis, a condition much to be desired.

Contracts should also be specific as to when final payments are to be made. Few jobs require more than ninety days after the work is completed to check up estimates and make final payment. In most cases this can be done in thirty days, but the time should always be named in the contract, and even if it is given as six months, it allows the contractor to know definitely upon what basis to work, which gives him an opportunity to make his financial arrangements accordingly.

### *Breaches of Contract.*

No man likes to be considered a "quitter." For this reason many contractors have lost and will lose much money. They obtain a contract, install their plant and forces on the work, and become intensely interested in the job. Possibly for the first few months a reasonable profit is obtained, and even better results are looked for. The contractor's best efforts are being put forth, when suddenly his monthly estimate is only paid in part, or not at all. Reasonable excuses are given, and many promises are made as to when the contractor's money will be given to him.

The contractor, relying on these promises, continues work, but he is in a predicament. All the expenses of installation have been met, and the work is proving profitable. If he stops, he feels that he will forfeit his contract, and must go to the trouble and expense of obtaining another piece of work, to which he must move his outfit at considerable cost. These considerations and the promises made to him lead him to go on with the work.

In so doing he makes a grave mistake. Nearly every contract for construction work provides for stated payments, mostly monthly. The instant the owner fails to meet these payments there is a breach of contract and the contractor cannot be held to the agreement. By stopping work the contractor does not forfeit any rights he has under the contract, for the breach comes from the other party.

It is never wise to act too hastily or arbitrarily in any matter, yet it is onerous for a contractor to continue work when he is not being paid. Ordinarily the course to pursue is to inform the other party to the contract that if payment be not forth-

coming at once, the forces will be stopped. This should be followed immediately by a letter, stating that work has been stopped, and will not be resumed except on the payment of all money due and a satisfactory guarantee given that future estimates will be paid promptly; also that if the money due is not paid on a definite date, the contractor will move his outfit and seek redress under the terms of his contract. If it is desired to extend the time given, this can be done by another letter.

If, however, the money is not paid on the date named, then the contractor should by letter signify his intention of leaving the job at once with his plant and forces, and referring to his previous letters, state that the contract has been broken by the owner not paying the estimates.

Then suit should be brought, not only for money due but for prospective profits. Such a procedure will prevent a contractor from losing much money. To continue may mean that several months' work might be done and the contractor receive no money for it, as the company or owner may have become bankrupt. Better be a "quitter" than lose money to such an extent that you may have to quit business altogether.

To some extent the foregoing remarks do not apply to public work, especially contracts with the national government. As explained under "Public Contracts," suit cannot be brought against the national government. At times contracts for such work are drawn up to make payments conditional upon appropriations. In other public contracts, however, specifying definite payments, there is a breach of contract, when payments are not made punctually.

Other breaches of contracts may be radical changes in location and plans that so alter the work that it no longer resembles that upon which the contract prices were named. The contractor should at once stop work and notify the other party of the contract by writing, and insist upon new prices being named. If this is not done, he can declare a breach of contract. This should be done under advice of a competent attorney.

Another breach of contract is delays caused by the owner and his agents, that add materially to the cost of the work, and prevent completion within the contract time. Such a matter is very difficult to handle and if the contractor is not careful he may forfeit his contract by a breach himself. Dating letters re-

ceived and plans are of great importance in such matters and expert advice should be sought early when such difficulty arises.

Interference on the part of the owner may also cause a breach of contract, and this is often done by verbal instructions or through oral agreements, which are repudiated later on. This shows the necessity of keeping a diary, in which even orders and conversations are recorded as well as other details.

Breaches of contracts can also come from the contractor, by delays in placing forces and men on the work, by neglecting to give the job personal attention, by failing to purchase the necessary materials, by not following instructions, by not living up to the time limit or other causes. Every contractor should see that a breach is not caused by him or any of his agents.

Whenever a breach is caused by either party of the contract, the contractor's sureties should be notified of the conditions at once. The contractor thus has some one to assist him in conducting any legal battle that may follow.

### *The Ownership of Construction Materials.*

The ownership of material taken out of a structure rebuilt under contract is a matter for which provision should be made in drawing up the contract. In many cases this is not an important matter, but at times it may mean much to both parties of a contract.

Sometimes contracts set forth such matters very clearly, while many of them do not make mention of old materials or anything of value found on the site of the work. On railroad construction there is generally land to be cleared, and some contracts provide that timber for poles, ties or bridge work must be cut to suitable length and piled up for use of the railroad company. This is sometimes done, but in many cases the provision is ignored. The general custom seems to be for the contractor to consider the timber cut as his property, except when it has been reserved by the original property owner, who generally secures that part which he wants himself. In most cases the contractor has but little use for such timber, except for fire wood, and there is seldom a market for it. There are some cases where the contractor will cut ties and sell them to the railroad company, or he may get out

foundation and bridge timbers for which he is paid in the completed structures.

If an old timber bridge or bridge floor is to be torn out, such material is generally considered to belong to the contractor, and when it is good enough, he makes use of it. Likewise, when masonry is torn down the material becomes the property of the contractor to be used again, either at the same place or in some other structure.

The practice varies as to old paving materials. Those of considerable value are reserved by the owners, but when they are of little value they are left with the contractor, even if he may have to go to some extra expense to get rid of them.

In tearing down buildings of any value, the custom today is to sell the building to the highest bidder, who tears the structure down at his own expense and depends upon selling the various materials and fixtures to make a profit on the job. There are now large concerns engaged regularly in this line of business, known as house-wrecking companies.

Steel bridges torn down remain the property of the owners. Therefore, a contractor bidding on a job of replacing a bridge, must figure the cost of tearing down and storing the old structure as well as building the new one. The same thing applies to the removal of machinery. If it is an engine, dynamo or similar machine, it remains the property of the owner.

Thus it appears customary that when the materials have but little value the owner does not claim ownership, and the materials are considered as the property of the contractor, or are left for removal by him from the place to be occupied by the new structure. However, if the old materials are of considerable value, they remain the property of the owner. These customary rules apply, unless the contract contains provisions clearly setting forth ownership. It is always better to make this provision, and then there is no reason for dispute. Without such clauses there is always a possibility of trouble.

In excavation work a contractor sometimes finds precious stones or minerals. These can seldom be claimed by him, and in some states they cannot even be claimed by the company for whom the contractor is working, unless the mineral rights are purchased when the land is bought. Such minerals revert to the original property owner. In other sections of the country they

belong to the last purchaser of the land, unless it can be proved that fraud was used to obtain the land, in the knowledge that valuable minerals were in the ground.

It is thus seen that neither by custom nor law does a contractor have the right to claim old materials of value from demolished structures, or valuable minerals or precious stones found on his work.

New materials for construction work are generally purchased by the contractor and the responsibility of caring for them is his even if he is paid a price for materials delivered. If floods carry away or fire destroys them, the loss is the contractor's. Under some specifications the contractor is held responsible for materials even when the owner furnishes them. If the specifications or contract do not provide for this, the contractor is not responsible. Under any conditions it is advisable to keep a watchful eye on all materials and take the best possible care of them.

### *Integrity of Contractors.*

Contractors as a class do not claim to be saints, but they are as honest, if not more so, than most business men. Moving from place to place and handling, as they do, large sums of money, it is seldom one hears of a contractor absconding and cheating his creditors. On the other hand we know of many cases, when contracts were not profitable ones, of contractors doing business as corporations, bankrupting themselves individually to meet the obligation of their companies. Few contractors have ever failed with money in their pockets.

Contractors, as a rule, stick too long to losing contracts. In most cases they are the injured party and they would be justified in abandoning the work, but you seldom find a contractor who will take such a course.

Contractors, sometimes, in carrying on their work, resort to practices that are to be condemned, but in most cases this is caused by unfair specifications and an unreasonable engineer. Thus the contractor, who has his capital at stake, is put on the defensive and it is but human nature for any one to take care of himself under such conditions.

A large number of contractors make money, but few of them amass large fortunes and die leaving vast wealth. Their financial

resources are generally overestimated; so it is rather ridiculous to state that contractors quickly make fortunes by graft. It cannot be stated too emphatically that a fair contract and equitable specifications, together with intelligent inspection, go a long ways towards making an honest contractor.

# CHAPTER II.

## FORM OF CONTRACTS.

EVERY contractor should be familiar with the different forms and methods of letting work, as he must execute contracts frequently and at times when it is very inconvenient to first consult with his attorney.

### *Various Forms of Contracts.*

There are a variety of forms and methods of letting contracts. Some forms have been used but little, while others have been in use since contracting methods have been employed. There are in all some eight or ten methods of letting work, but they are all some variation of the following well defined methods:

1. Contracts let on the unit basis.
2. Contracts let for a lump sum.
3. Contracts let on a percentage.
4. Contracts let for cost plus a fixed sum.

Under these heads come the many variations, such as the two ways payment, percentage bidding, keeping within certain percentages, force account contracts and lump sum and percentage work. Some of these are not necessarily different in form, only in bidding on the work, but this difference in the end means a variation in the form of obtaining and carrying out the contract.

### *Unit Price Contracts.*

To let contracts on the unit basis is one of the oldest methods of letting work, and although there are some objections to it, yet it possesses many advantages.

### *Unbalancing Bids.*

Many of the forms of bidding and contracts that have been tried within the past twenty years, have been devised almost en-

tirely to overcome the objection of unbalanced bidding, under the unit price method. Unbalanced bidding has been carried to extremes, especially in connection with city work. For laying pipe, for instance, contractors have been known to bid an exceptionally high price per ton delivered and only a cent per lineal foot for excavating and refilling the trench and laying the pipe. On paving work, likewise, contractors have frequently bid one cent per lineal foot for finishing and laying curb, and then added the deficit on the curb to the other items of work. In the pipe work it is very evident that the bid is gotten up in this unbalanced manner so as to have a high price for material delivered and obtain large payments on the contract before any of the work is done. This method sometimes allows a dishonest contractor to collect nearly all the money due on his contract and then refuse to do any more work.

On street work it is evidently the intention to hide the prices bid on the various items of work. These are all tricks and cannot be defended even from the contractor's standpoint.

There is another method of unbalancing bids, for which a defense might be made. A contractor bidding on a job notices a small item of work listed in the preliminary estimate and upon investigation comes to the conclusion that this class of work will greatly increase, and accordingly bids a price slightly higher than he would otherwise have done. This class of work does increase with a corresponding decrease in the cost of doing the work, with the result that a very handsome profit is realized on this one item of the contract. The writer remembers a case of this character. A contractor bidding on a large railroad contract noticed that there was an item of a few thousand feet board measure of timber guards to be placed at the ends of embankments, at pile bridges or timber trestles. There were a large number of bridges and the contractor reasoned that if timber guards were necessary for a few openings, they would be needed at most of the bridges. He accordingly bid a price that was a little higher than ordinarily paid for such timber work. After construction commenced, the contractor's surmise proved correct, with the result that he made a large profit on these timber guards, much larger than on any other item of work. In a measure the contractor was entitled to this as he was able to size up the situation more quickly and better than the engineer who had planned the work. It was a case

of matching one man's wits against another's, and the contractor won.

The unbalancing of bids is a benefit to the individual contractor, but in the end it works a hardship on the profession of contracting. It is against all economic laws, and contractors should assist engineers in preventing unbalanced proposals being made. It can be termed a petty form of graft, as excessive payment is made for work, by obtaining more than a recognized or legitimate profit.

In discussing the unit price method of letting work, this objection to it must be kept in mind, that contracts let on this basis consist in estimating all classes of work to be done, setting a unit for measurement and payments at the stipulated price. When all classes and quantities of work are formed or estimated, then it is possible, by applying the unit prices, to know the cost of the work before it is started, but if all quantities of work to be done are not known, the exact cost cannot be obtained until the job is finished. If changes are made in the work during its progress, the contract is not affected, as the unit prices remain unchanged and an increase in quantities is paid for at the stipulated rate, while a diminution will in no wise increase the cost. It is possible under this form of contract, provided prices have been named for every class of work to be done, to do the job wthout bills for the extras.

*Force Account Work.*

This item of extras is one over which many law suits have been fought. When work does not come within the contract it is done as "force account" work; but it would be better for the profession if it could be entirely eliminated from construction work. To obviate having extra work, a price should be named for every description of work that may be encountered, even though the engineer's estimate may not include all such items. Two classes of work should not be included under one price, but a strict unit basis should be maintained throughout the specifications and contract. The hauling and delivery of materials can also be arranged for under the unit basis. Hauling can be paid for per ton mile, or on a similar basis. Materials can be paid for first as delivered and then in place. With only a price for materials in place, contractors may be slow in providing them, but should the owner

furnish them, the contractor will more than likely be extravagant and negligent in caring for them.

*Two Way Payment Contract.*

A "two way payment contract" is a unit basis contract but instead of paying for the work under one heading, it is paid for under two items. This method was very common at one time for excavation, and is still used to a limited extent. For instance, when earth is excavated and placed in an embankment, instead of setting one price to cover the entire operation, a price is set for excavation and another for placing the material in the embankment, thus making a two way payment. However, if the material is excavated and wasted, or if material has to be borrowed for embankments, only one payment is then made. There is little to recommend this method excepting unusual conditions.

A good many public contracts are let on a unit basis, but the units of work selected often consist of several items or classes of work. Thus, under the head of concrete, such work as excavation, pumping, shoring, and the concrete is paid for as one item. If any of this work is not needed, such as the pumping or shoring, then the contractor is paid for work he does not do. Under this plan it is to the interest of the contractor to make his excavation excessive so as to receive pay for extra concrete. This could happen if each item were paid for separately, but it is not likely, as the excavation must then be measured by the engineer, and the checking up of work in this manner will prevent this.

In letting work on the New York State Barge canal, bids were taken on a unit basis, and in order to prevent the bids from being unbalanced, the state engineer's estimate of the cost of doing the work was published and given to the contractor before he made his bid. He was advised that his bid would be considered informal and rejected if it varied more than 10 per cent in the total from the engineer's estimate, and 20 per cent on any one item. This method has not proven satisfactory in every respect, but it has been a step in the right direction and was a help in preventing the unbalancing of bids.

The unit basis form of contract is especially adapted for railroads, canals, bridges, reservoirs, dams, ditches, walls, wagon roads, streets, sewers, conduits, terminals, subways, filter beds, pipe

lines, transmission lines, all forms of excavation and many other kinds of outdoor construction.

### *Lump Sum Contracts.*

Lump sum contracts are those by which a contractor agrees to complete such work as is listed in the contract and specifications and shown on the plans, for a specific amount of money. In this form of contract every detail must be thought of before bids are asked on the work and plans and specifications must be complete, otherwise the lump sum will not be binding on either party of the contract.

Lump sum contracts are very popular in some sections of the country and for certain classes of work. Many engineers seem to prefer this form of contract, but the author believes that contractors as a class have a decided preference for unit price contracts. This preference was shown at the first letting of work on the Barge canal of the state of New York. Contractors were asked to submit either itemized bids or lump sum proposals. Most of the contractors bid unit prices. The Superintendent of Public Works, before making the final awards, submitted the merits of the two methods to a special board of engineers who decided it was for the best interest of the state to accept only unit price proposals.

The fundamental basis of all successful construction is that the work of the engineer be complete and thorough. This fact controls all bidding. The general public has become so accustomed to reading of large bills for extras, in connection with public work, that lump sum contracts have been turned to, as the prevention of these conditions. If the engineer's estimate is complete in every detail and so designed as not to admit of improvements during the progress of the work, then a unit price or a lump sum contract should give the same results as to cost, and there would not be any extras to be paid at the end of the job.

This is based on the supposition that the engineer's estimate is complete, but both engineers and contractors have learned that the estimates are seldom verified by the costs of construction. Consequently, when a contractor makes a lump sum bid he must add a percentage to cover the small changes and chances of increased costs, for which a claim for extras cannot be made after the job is finished, which adds to the cost of the whole work. Such a per-

céntage is not needed when the contract is based on unit prices, as the contractor does not assume the same risks.

This form of contract is objectionable, as every dollar the contractor saves on the work goes into his own pocket, and changes made to cut down the costs do not necessarily mean a saving to the owner. It is difficult to live up to a time limit with this form of contract, as almost any changes in the plans will make the limit set of little value.

The following are some of the reasons against lump bidding:

(*a*) Unit prices are not named in the contract for increased amount of wŏrk that may be made necessary by changes in the plans, or caused by incomplete survey; neither can money be deducted for decreasing the amount of work. Allowances made by the engineer for changes, in most cases would not be satisfactory to contractors, causing disputes when these parties disagree and frequently ending in suits at law.

(*b*) Contractors object to this method as a specific sum is not stated in the contract to be paid as a monthly estimate, as in the case of a unit price contract, but the amount is left to the judgment of the engineer, who is more likely to underpay than overpay the contractor.

(*c*) To ask for lump sum proposals may in itself be a confession of incomplete surveys and hastily made estimates.

(*d*) This risk and all others the contractor must run, and as he has to assume the entire responsibility, he must ask an increased price to cover it. He has his money and property at stake and must protect them. The contractor, under this system, is expected to check, in a few days, all surveys and estimates, which may have taken the engineer months or years to make. As it is not possible to do this, he must add to his price to cover the possible errors made by another. Under the unit price method he studies the cost of each item, bids accordingly, and the corporation letting the work pays for it as it is actually completed under the supervision of their engineer, and as the work progresses.

(*e*) Lump sum bids, not setting unit prices, cause all extra work to be done by force account. Men do not give as efficient work under this system. The contractor may not object to this, but the engineer should. On public contracts of any size this may be a prolific cause of charges being made of collusion against the engineer and contractor, when none really exists.

(*f*) On lump sum work the personality of the engineer counts for much, hence to change engineers after the contract work is under way means a hardship to the contractor. This fact may also limit the number of bidders on the job, as many contractors do not care to have lump sum contracts under engineers they do not know.

This form of contract is much used for buildings, the furnishing and setting of machinery, the building of sewers and water supply plants, the construction of power plants and many other jobs. It is frequently resorted to for irregular work.

The national government lets a large number of lump sum contracts and in order to vary from the established amount of work to be done they ask the contractor to name unit prices for additional work that may be necessary, and also prices for work that may be omitted. As a rule, contractors name a higher unit rate for additional work than for work to be omitted. This in itself shows that it would be more economical to let the work on a unit basis.

*Percentage Contracts.*

The percentage plan of letting contracts is also known as "force account work" and consists in doing construction under a contract at cost for labor and materials, plus a fixed percentage for superintendence and profit. This percentage varies from 5 to 25, but on most work it is generally 10 per cent. This percentage is too low for these days. When but little machinery was used on construction work 10 per cent was ample for tools, superintendence and profit, but with expensive machinery another 10 per cent should be added.

When one considers that the more the work costs the greater is the profit of the contractor, it is patent that this method of doing work is objectionable, and against all business principles. Much work is done under this form of contract, but there is not a class of work under this method that could not be done under some other.

This method must not be confused with the "percentage bidding," which is a method now being used by a number of cities to prevent unbalancing bids. It is a variation of the unit price method.

*Cost Plus a Fixed Sum Contract.*

The cost plus a fixed sum contract is a variation of percentage work. The owner pays actual cost for all labor and materials and in addition a fixed sum for profit to the contractor, who brings to the work his organization and knowledge of construction. By this method each party knows in advance the profit to be made, but the total cost of the work need not be known and seldom is. There are advantages and objections to this method. Some of the advantages are: the owner's and contractor's interest should be identical as increase of cost will not add to the contractor's profits; the owner must pay the entire cost of the work as the contractor risks neither his time nor his money, as he does under the lump sum method; there can be no dispute as to extras, as they cannot occur; changes can be made in plans and specifications whenever it suits the owner; work can be started before all the plans have been made; the owner can take possession of any part of the work at any time and not wait for the entire job to be completed. The incentive of the contractor should be to do the best class of work and to do it as rapidly as possible. The fixed sum charged is generally about 10 per cent on the total estimated cost of the work, but should the work cost more or less than the estimate the profit still remains fixed.

One objection to this style of contract is that the contractor ceases to be a contractor in the true sense of the word, as he becomes a labor agent and a superintendent of construction for the owner. This form of contract also creates a tendency to take from the engineer and architect certain work that is rightly theirs and also to rob them of prerogatives. Differences may arise between the owner and his engineer or architect, caused by the position taken by the contractor.

The contractor may be placed in an unusual position as to buying and using outfit, when special machines are needed for the owner where he would not be willing to pay the entire cost of such machines, while the contractor would not wish to purchase, as he might never have use for them again. This may cause the job to be done without the proper machinery. The contractor is liable to get a bad name in the labor world, as at the command of the owner he is compelled to mass large numbers of men on a piece of work for short periods of time, and then must discharge them

as soon as the material is used up. It is but natural that men should resent this. Under other methods the contractor maintains a force of men that he can work economically at all times. The cost plus a fixed sum method has a tendency to throttle competition, as the nature of the contract is more of a deal for each job than a proposal and competitive bid. It is a case of calling in a contractor and offering him the work.

The cost plus a fixed sum method is used for all classes of construction, but if it has any special merit it is in foundation work and other construction where it is very difficult to estimate the work to be done, and also to keep a record of the work as it is completed.

*Panama Form of Contract.*

A form of contract that has had but little use in this country was to be tried out on the Panama canal when the national government thought of letting that work to contractors.

The plan as outlined by the Canal Commission was, in brief, as follows: A contractor or a legally formed association of contractors experienced in the various classes of work to be done on the isthmus, who could show an available capital over all debts of $5,000,000 and who were able to make a bond for $3,000,000 and a deposit of $200,000 in order to submit a proposal, were asked to associate themselves with the Canal Commission upon the following basis:

The government was to furnish all dredges, steam shovels, cars, locomotives, heavy machinery and working plant, as well as all material, such as lumber, cement, iron, steel and other raw materials. The contractor was to do all the work of construction, furnish all labor and pay it. Each month he was to receive the money so expended and at the end of the year he was to receive a percentage on this labor. It was this percentage that the contractor was to name in his proposal. No matter how much the cost, the government was to pay it. The contract provided that after proposals were made and the contract was awarded the successful contractor was to name two engineers of his own selection who, with three named by the commission, one of whom was to be the chief engineer of the commission, were to estimate the cost of labor to be used in building the canal and the time necessary to complete it.

The percentage bid was to be applicable to this cost and for this time. If the contractor could reduce the cost he was to receive one-third of the saving he effected. He was also to receive a bonus of $100,000 for each month he saved in time of completion.

Had the cost exceeded the estimate of the engineering board the government was to pay it, but one-half of one per cent was to be deducted from the percentage bid for each $5,000,000 by which the actual cost exceeded the estimate cost. A penalty of $100,000 for each month of extra time needed over that of the estimate was to be inflicted on the contractor. The contract was not necessarily to be awarded to the lowest bidder, but to those who showed from past records their ability to carry on important work and could meet all the requirements of the commission. All of the expenses of the contractor other than those on the isthmus for clerks, legal advice and cable tolls were to be paid from his percentage, also all damages and injuries to plant furnished by the commission. The contractor was likewise responsible for all suits for injuries to men.

This form of contract makes the contractor a labor agent to procure the necessary men to carry out the contract. Also a superintendent in carrying out the instructions of the engineer in charge. The contractor does not have to assume any risk as to the cost of the work, but he must put at the command of the government his capital and bond, for damages and injuries and for a wrong estimate of cost and length of time necessary to finish the work.

These things condemn this form of contract. Besides the contractor before making his proposal can have but little knowledge as to what time limit and cost will be set by the board of engineers. If they underestimate the cost and time necessary to finish the work, by any decided amount, the contractor would forfeit his capital in penalties.

The tendency of this would be to make the contractor name a large percentage. This form of contract is somewhat similar to cost plus a fixed sum, but in the author's opinion is not favorable to the contractor.

### *Percentage Bidding Contracts.*

In some of the eastern cities this form of contract is used and advocated. The engineer makes estimates of unit prices of the work, or lump sum estimates and asks contractors to bid prices

based on a percentage of his estimate. This method can be classed either under unit price or lump sum contracts. Seemingly this overcomes unbalanced bidding, but it does not as the contractor can unbalance his bid by his percentages, or by collusion with the engineer who will make high estimates. Some safeguards can be thrown around these features, but it is doubtful if this form of bidding and of contracts will grow in favor.

### *Assessment Contracts.*

In some of the western cities and in California, contracts for public work are let under acts that make the contractor collect his money from the tax payers. Certain classes of work have been done in this manner for some years in St. Louis. In California, for any work done under the "Vrooman Act," warrants for taxes or assessments are issued to the contractor and he must collect his money with these.

This is found to add to the cost of the work, even if the warrants do not have to be discounted at a bank as the contractor must furnish capital to run the job to completion, as he cannot be certain when he can realize on his warrants. His capital and interest charges are higher and he runs some risks of not collecting money on all his warrants. The contractor is also made a tax collector and collecting money is always worth from five to ten per cent.

### *Contract and Specifications.*

The contract itself should be separate from the specifications; yet each document should refer to the other, and in each there should be a clause making the specifications, plans, profiles, etc., a part of the contract and vice versa.

A contractor frequently wishes to place copies of the specifications in hands of different employees, so that the work may be done accordingly, but the contractor does not wish his men to know the prices he is receiving for his work. On public contracts anyone can easily find out the contractor's prices, but on private work, if the contract is made separate from the specifications it is possible for only a few people connected with the work to know the prices.

### *Keeping Prices Secret.*

Prices should be kept secret as much as possible, as it is a matter that only concerns the two parties to the contract and often indifferent work is done by a contractor's men, by everyone knowing his prices. For instance, foremen will say the prices are too low, and no one can make money with those being paid, with the result that men are allowed to do indifferent work and a profit is not made. Reports are also often falsified to show better results than are obtained and to show a profit at the prices paid. If the prices are high and they are known it is an incentive to be extravagant.

If work is being let to sub-contractors the prices should be kept very secret, as it is of no concern to the sub-contractor as to the prices being paid the general contractor, nor is it any concern of the various sub-contractors what prices each is receiving for his part of the work. Too much publicity is given to prices and this has been an injury to contracting. For public work the prices must be known, otherwise there would be graft in the letting of nearly all public contracts.

### *Legal Features of Contracts.*

A contractor should always have a competent attorney to whom all matters of law should be referred, but at the same time he himself should be posted as to some features of the legal aspect of contracts, as ignorance is never an excuse before courts. In Chapter I, public contracts have been discussed to some extent and a few words may not be amiss as to commercial corporations.

Contracts of corporations are limited to the powers given them by their charters, and a corporation has only those powers specified by the law. A contract made beyond these powers and limits is void, neither can it be made valid by subsequent acts. It needs but one dissatisfied stockholder to such acts to have them disavowed. A railroad, chartered only as such, can not legally make a contract to develop and operate mines, neither can they contract for work to cost more or exceed the amount of their indebtedness fixed by law, without amending their charter. Only certain officers have the power to enter into contracts and a contract made with other than such officers is of no effect. The author had one experi-

ence of this nature. He made a very favorable contract with the treasurer of a corporation, but as the latter had no power to make contracts, it could not be enforced, and it became necessary to make a new contract with the corporation's president upon less favorable terms.

Every chartered corporation is compelled to file its charter with the secretary or comptroller of the state from which it derives its existence. Many states also compel foreign corporations to be registered with the secretary of state. Under such circumstances a contractor can always post himself as to the powers of corporations with whom he contemplates doing business.

Another very important feature of contracts is the plain dating of them. This is necessary for many reasons, and may be a salient point in contracts on public work as showing whether or not certain legislation affects them. It is also essential that the residence of the parties to the contract should be inserted, stating whether the parties are chartered corporations of copartnerships. This may be necessary to establish, under the laws of which state the several parties' rights may be asserted and maintained. This becomes a special safeguard, when it is not the custom to set forth in the contracts at what place the articles of agreement are drawn up, or give the name of the state where the work to be done is located. Should a law suit grow out of such contracts these clauses are absolutely requisite.

A general knowledge of such laws will always be found of use to contractors, both those doing a general business and also subcontractors. It is well to bear in mind the difference between contracts for public and private work. On public work the engineer is not at liberty to use his discretion and change clauses and provisions of the contract and specifications, as he may do under private contracts, but he must carry out the law as it is laid down for him. Any dissatisfied tax payer can call him to account and the courts will decide against the contractor if any law has been violated.

# CHAPTER III.

## PROPOSALS, BONDS, ARBITRATION AND OTHER FEATURES OF CONTRACTS

PROPOSALS made for construction work, either on regular forms or by letters, are preliminary contracts and are binding on contractors. Some construction contracts make proposals a part of the regular contract and are incorporated in the articles of agreement. Proposals should therefore not be made without thought and contractors will do well to bear in mind that any proposal can be made binding on them. In order to hold contractors to a proposal, when they wish to revoke it, a suit at law is necessary. In order to avoid such suits and to enforce proposals certified checks or bidding bonds are demanded when proposals are made. These, however, will not hold a contractor should he desire to forfeit them. In most cases, however, they act as an incentive to make good the proposals.

### *Proposals for Public Work.*

Proposals for public contracts are, as a rule, made on forms prepared for the occasion, and are sometimes made a part of the contract. All proposals, whether for public or private work, should be made out strictly according to form for the work as outlined and for such items as are listed. The plans and specifications should also be followed, and all instructions given regarding bids and proposals be carried out to the letter. It is only in this manner that the proposal can be considered formal. If the proposal is informal in any respect, then by protest of other bidders or, on public work, by protest of a tax payer or industrial or commercial organization, the bid or proposal must be thrown out. Should the contractor wish to make another offer, as to plans, methods of doing the work, or a change of specifications, or even as to different materials being used, he should fill out the proposal form according to instructions on another form or by letter submit an alternate proposal. He has then conformed to all the necessary requirements.

Should his methods of doing the work or other features of the construction be patented, he should ask the owner for alternative propositions, and if this is not possible he must submit his proposal according to due form. Under the last conditions he will seldom obtain the work.

In making proposals care must be used as to figures written on the forms. Mistakes are easily made in placing decimal points and also in placing ciphers. Such mistakes may be very disastrous. For this reason all proposal forms should have space provided on them for writing out the prices submitted, as well as to give them in figures. Care must also be taken in making out proposals as to the units of work that prices are to be submitted upon, as cubic feet are used in some localities, while cubic yards may be the unit in other places. Many other units also vary.

In Chapter II, reference has been made as to forms of contracts, showing that the style of contract varies to some extent, as to the method of making a proposal. This alone shows the importance of proposals. The proposal is really the essence of the contract. If the prices submitted are not proper a profit cannot be made upon the work.

### *Limiting Proposals.*

Nearly all proposals are dated, whether they are made by letter or on regular forms. On the other hand, a limit of time for the acceptance of the proposal is seldom given. This may be important in some cases. Ordinarily the award is made on proposals received within a few days or a few weeks. Under such circumstances a limit on the time of acceptance is not necessary, but if the letting is held up for some time then it may make a decided difference to the contractor. He may obtain several other jobs, or conditions under which he bid may change. The prices of materials may go up, so that there is no longer a profit in the proposed job at the figures submitted. For these reasons a time limit on the acceptance should be named. If the proposal does not state that the prices are for immediate acceptance or set a limit of time for such an acceptance, then it becomes necessary to write a letter after the proposal is made, notifying the owner, or his agent, of the proposed work, that unless the proposal is accepted within a certain time it is withdrawn. This is what every wide awake mer-

chant does when he quotes prices upon his goods. Unless a time limit is set, the contractor can be held to his proposal for months after it is submitted. The author has known of cases of this kind.

A complication that may arise in this connection is in public contracts, where certified checks are deposited with the bids. Although the contractor may withdraw his proposal, the owner can hold the contractor to his bid by refusing to give back the certified check.

*Engineers' Estimates.*

It is customary on all construction work for the engineer for the owner to make an estimate of the cost of the proposed work. Seemingly this estimate is of small importance to contractors; yet it may be a vital matter before the job is finished. Contractors should be interested in engineers' estimates.

What is an engineer's estimate? For years it has been little more than a guess at the cost of the proposed work, even when the actual qualities of the work to be done are known and changes in construction are not found necessary. This has been caused, more or less, by engineers using prices of other construction work rather than actual costs. The result has been that estimates made by engineers have been more or less of a guess. If the quantities were subject to change and the prices guess work, then it is evident that the total estimate might vary exceedingly when the work is finally completed. There have been numerous examples of this character. A long list of great undertakings, which have cost many times the estimated cost, could be cited. The most recent example is the Panama canal.

A marked improvement has been made in this connection during the past decade. Engineers are learning much about costs and in some cases are more proficient in such matters than contractors, many of whom still guess at them. Engineers are not always to blame for incomplete surveys and low estimates. Frequently tentative estimates are used purposely by officials of corporations and promoters as complete estimates. In many cases underground explorations and surveys have been poorly done in the past with the result that from lack of knowledge the work cost much more than estimated. Sweeping and decided changes in the plans, which the engineer may have advocated from the start, are sometimes ordered after the estimate has been made. It has been stated that a com-

petent engineer, knowing that it will affect his estimate and throw discredit on his work, does wrong in submitting himself to such criticism, but one must bear in mind that engineering positions are difficult to obtain, and even if the engineer resigns another will no doubt take his place and do the things the first has refused to do.

*How Contractors Are Affected by Underestimates.*

Contractors often suffer from the discrepancies and blunders in estimates. Should the work be of a public nature the ultimate contract price may exceed the appropriation, and the contractor may be held up on his work or on his final payments, or it may even happen that the contractor cannot recover for all the work he has done. If the contract is a private one, the extra cost may mean the financial ruin of the enterprise with the consequent stoppage of the work, and a possible heavy loss to the contractor. These things happen. Another manner in which contractors are affected by engineers' estimates is in accepting and rejecting bids. For instance, an engineer's estimate for a proposed sewer may be much too low, and after a number of contractors have each spent several hundred dollars and considerable time in making investigations and estimates and in submitting proposals, they are informed that their bids exceed the estimate of the engineer, with the result that all proposals are rejected. This may happen several times for the same job. The author believes that when the engineer's estimate is to be used as a basis for accepting and rejecting bids, that it should be made public before the bids are submitted, so that the contractor can have the estimate verified, and if it is found too low, he need not waste time and money in bidding.

This was done on the New York State Barge Canal. To make public the engineer's estimate is to show confidence in contractors, and inasmuch as the engineer and his assistants have spent considerable time and money in getting up the estimate it would be of vast assistance to the contractor, who may have but a few days to make an estimate. If the estimated quantities are made public, and as a rule they are, then there should be every reason why the estimated prices of the engineer should be made public. In public contracts where the proposal is made a part of the contract, it would seem advisable also to make the engineer's estimate a part of the contract. This would serve several purposes. It would fix upon the

engineer the responsibility of making a correct estimate. It would serve in fixing the cost of the work and showing prospective profits in case a contractor should underestimate the work and obtain the contract, and afterwards finding he was losing money, by picking a flaw in the contract or specifications throw up the job and bring suit for prospective profits. Then the engineer's estimate, being a part of the contract, could be introduced as the work of an expert, showing the cost of the construction with a reasonable profit, as made up before the contract was let.

### *Certified Checks and Bidding Bonds.*

In asking for proposals, especially on public contracts, it is customary to stipulate either a certified check, a bidding bond or a cash deposit. The cash deposit is seldom used, except when the amount is small. A small cash deposit is often demanded in order to obtain the plans and specifications, which sum is given back to the bidder upon the return of the plans and specifications in good condition.

Certified checks and bidders' bonds to some extent guarantee the entering into a contract by the successful bidder, as well as showing his standing. A bidding bond has many features to commend it. A bonding company, through its experts, passes upon the financial standing of the contractor as well as his reputation for making and carrying out contracts. This is a help to the engineer whose investigations into such matters are to be limited. The bonding company will insist upon the contract being signed properly and promptly, in order to be relieved of its responsibility. The contractor's only objection to such a bond is its cost, but that is small and may not equal the interest on the certified check.

Many contractors prefer to deposit a certified check. There are many abuses regarding this custom. It is seldom stated how long such checks are to be held before they are returned to the unsuccessful bidders. This is wrong, as many contractors of limited means cannot afford to wait indefinitely for the return of such sums of money, and are frequently compelled to borrow money to allow these checks to remain on deposit. This could be obviated by stating specifically the length of time the checks are to be held. The amount of the check should be given as a specific sum, large or small, according to the size of the contract, and not a per cent of

the amount of the bidder's proposal. Frequently five or ten per cent of the bidder's estimate is the amount asked. This at times may give to competitors information regarding a contractor's total bid, as bankers are frequently interested in contracting operations as partners of contractors, and such knowledge coming to them is certain to be taken advantage of and used by the banker and his friends. The amount of the check could become known in other ways. Some specifications call for checks only on local banks, which is a discrimination, as strangers to these banks may at times have to pay for such certification. All these facts should be carefully considered.

A practice to be commended is that adopted by some divisions of the army and many departments of the national government, of having contractors make an annual guarantee bond to cover proposals made during the year. This does away with certified checks. These bidding bonds guarantee that the contractor will enter into a contract, within ten days of its award.

### *Bonds.*

In nearly every contract of any size or importance there is a clause calling for a bond to be made by the contractor in favor of the other party to the agreement. These bonds are either furnished by a surety company or are personal bonds. Personal bonds are not much used now, as no one wishes to see a friend lose money on his account, and they are only furnished either for very small contracts or when surety companies refuse to write the bonds.

There are three forms of bonds in general use on construction work:

(1) A bond made for a stipulated sum or a per cent of the amount of the contract for the faithful completion of the work at the contract prices.

(2) A bond not only calling for the completion of the work within a specified time, but also calling for a fixed sum to be forfeited each day the job is delayed beyond the contract time.

(3) A bond similar to the second one, but also allowing a daily bonus for each day that the job is finished before the day named in the contract.

Besides the bond a percentage of the monthly estimates is also retained by the company until the contract is completed.

The ordinary bond is either for a stated sum or for a certain per cent of the total amount of the bid; the life of the bond being until the work is completed and final settlement made between the parties of the contract. The purpose of the bond is to hold the contractor to his agreement, yet the cost of the bond is paid indirectly by the other party to the contract, the contractor having included its cost in with the other expenses of the work. The more irksome and strict, the longer its life, the greater is the cost of the bond, and this also applies to the specifications and contract governing the work. It is an easy matter to overdo this phase of contracting. An engineer, by making his bond too strict or unprecedented, may injure his employer's interest rather than serve it.

The first named bond is the one most frequently used and covers most classes of work satisfactorily.

The second and third are bonds used for jobs upon which a strict time limit is set and when the completion of the job is of great importance, and the matter of a day or week is of monetary value to the owner.

*Retained Percentages.*

It is the custom on most contracts, in addition to having a bond, to retain a percentage of the monthly estimates until the work is completed. This is known as "the retained percentage," and besides protecting the owner against overpaying the contractor on monthly estimates, which are supposed to be only approximate, also acts to compel the faithful carrying out and completion of the contract. The amount generally retained is 10 per cent, although on some contracts 15 and even 20 per cent of the monthly estimates are sometimes held by the owner. On very hazardous jobs such as deep foundations and dams, 25 per cent is sometimes retained and the writer has known of one case where 33⅓ per cent of the estimates was retained. Occasionally general contractors who sublet much work have 10 per cent retained from their estimates and they retain 15 per cent of the sub-contractor's monthly estimates.

If the contractor breaks his agreement the retained percentage is forfeited. The amount of the retained percentage is increased each month and the forfeiting of this actual cash is a greater incentive to the fulfilling of the contract by the contractor than the bond. Instead of compelling a contractor to make such

a large bond for the entire life of the contract, it could be stipulated that only a bond for a nominal amount be made, to run until the retained percentage reaches a specified amount, or for half the life of the contract, when the forfeiting of the percentage will act as security for the contractor doing his work. This, with equitable and specific specifications, will reduce the cost of the bond and thus reduce the cost of the work to some extent. Fair and equitable contracts and specifications mean not only cheaper construction, but also that a contractor can be held to his work more easily. Such a form of contract and specifications is a good bond in itself.

The author knew of one contract that only called for the holding of a percentage of the monthly estimate, until a specified sum was in the company's hands, when the estimates were paid in full. A contractor figuring on such a job could certainly afford to cut his price under one that called for both a bond and a large retained percentage. Now and then we find in specifications and contracts such unnecessary and stringent conditions, surrounding the bonds and their making, as to add substantially to the cost of bonds, and yet neither party to the contract is benefited. An engineer, who should bear in mind the economic side of his work, clearly does wrong in making such stipulations.

Bonds with penalty clauses are always expensive, and in case of any dispute (even where they state that the amount forfeited is in the nature of liquidated damage), the courts look with disfavor on such contracts and bonds and actual damages must be proved and sustained, before the courts will allow them. It is the same with contracts with both bonus and forfeit clauses. When it is necessary to have such contracts, the bonus should be made the same amount as the penalty, and not less, as it is too often done. If the company is injured to the amount of the stated sum, for each day's delay, it must be benefited by the same amount for each day the contract is finished ahead of time.

To recapitulate: In asking for bids the time should be specified for holding certified checks of unsuccessful bidders. Proposal bonds and certified checks should be for a stated sum and not for a per cent of the amount of the bid.

Bonds for faithful completion could be made to expire before the end of the contract, when the retained percentage has amounted to such a sum as would guarantee ample protection to the company letting the work. On small contracts the retained percentage need

only be deducted from the monthly estimates until a specific sum has been held, when full estimates could be paid.

In bonus and forfeit contracts, the same sum should be named for both.

*Forfeitures.*

Under this head several things are to be considered. The first forfeiture in connection with contracting is that of a certified check that has been deposited with a proposal. Should the contractor, to whom the work is awarded, fail to enter into a contract and make the proper bond, the certified check or bidding bond is declared forfeited. There are comparatively few forfeitures of this character as most contractors bidding are equally anxious to secure the work. If, however, a contract is not signed, through the fault of the contractor, and his check is declared forfeited, he of course has the right to bring suit to recover it. Court decisions on such forfeitures are few, but penalties are seldom upheld by the courts. Damages to the extent of the amount of the check must be proved. This is done by showing the difference in cost of having the work done by another contractor and the one to whom the job was first awarded. If the difference in cost and the possible delay does not amount to the sum for which the certified check was written, the rest could no doubt be recovered by the contractor.

Another forfeiture is a penalty per day, week or month, for not finishing the work within the contract time limit. As previously stated, there should be a bonus offered for an earlier completion, when a forfeiture is demanded, and each should be for the same amount. These forfeitcures or penalties are no longer termed such in the contracts as the courts will seldom uphold a penalty, so they are called "liquidated damages, previously agreed upon." Nevertheless, if a contractor refuses to submit to such sums being deducted from his payments, the owner must prove to what extent there has been monetary damage.

Contracts are forfeited when there has been a breach on either side. When the contractor forfeits the contract he loses his retained percentage. It is possible for the owner to have the contract finished, crediting the contractor with the full amount of work done and at his prices. Then charge the cost of the work to him, and if this exceeds the former, the difference can be recovered by law. In like manner, if the breach is caused by the owner, the contractor

can recover for his outlay and for anticipated profits. Some contracts provide that if a contractor forfeits his contract, the owner can take over the contractor's outfit and finish the work. This is a great injustice to a contractor as it prevents his obtaining other work and continuing in business.

When forfeitures of any kind occur a contractor should act upon the advice of a competent attorney, otherwise many of his legal rights may be overlooked until it is too late.

### *Time Limits.*

The limit of time set forth in a contract is frequently termed the "essence of a contract." This shows the vast importance of time on construction work. A contractor cannot, under most circumstances, expect to underbid a competitor to any great extent, therefore he must depend, especially on private work, upon his reputation as a contractor to obtain many jobs. Reputation must be built upon the excellent class of work he does, the fact that he can get along in business matters with other people, and especially that he completes his work on time. Time is nearly always a consideration, and so many contractors fail to finish their jobs within the time specified, that those who do are always in demand. One prominent contractor built up a large business through judicious advertising of the fact that he finished his work in the shortest possible time.

Many contracts contain clauses setting forth the progress of the proposed work. Engineers do this in many ways, and seldom obtain the desired results, and frequently disputes arise over the progress, which are not satisfactorily settled. An engineer wishing to maintain a specified rate of progress, can best obtain this end by setting forth in detail the kind and amount of outfit to be placed on the job and set a limit of time in which these clauses shall be carried out by the contractor. The contract could also specify the minimum force of laborers to be employed. These are the factors that govern the progress that can be made, for if sufficient and suitable outfit is not placed on the job promptly, with the necessary force to operate it, the job cannot be completed by the date set, or satisfactory progress maintained. Stringent bonds and progress clauses will not perform work, but they may add materially to the cost of the job.

*Award of Contracts.*

Private contracts can be awarded to anyone whom the owners wish to give the work, and bidding can be restricted as much as possible, but public contracts must be awarded according to law. In many cases the law compels the award of the contract to the lowest responsible bidder. Bids must be received from all who qualify according to law, but those who are not responsible need not be considered in making the award. The practice is growing to so change the law as to reject any bid, thus allowing boards of award to exercise their judgment and award contracts to other than the lowest responsible bidder. Which is the better plan is difficult to say, as there are decided objections to both methods, and yet much that is favorable to each could be mentioned. When the contract goes to the lowest bidder, the chance of fraud and collusion is reduced to the minimum. All laws give the right to reject all bids and after re-advertising accept new bids, upon which an award can be made.

*Arbitration.*

Many engineers and contractors favor arbitration clauses in contracts, believing that in some cases of dispute lawsuits can be prevented. The idea is an excellent one, but unfortunately it is difficult to carry out. Various methods of arbitration have been devised in the United States, and some contracts set forth how arbitrators shall be selected and sometimes give rules to govern their work. The whole idea is to prevent lawsuits and to obtain quick settlement of points in dispute.

At times one man is selected as an arbitrator or referee, and he makes such investigations as he sees fit, questions witnesses and principals on both sides and makes a written report on the controversy. When there is much feeling in a dispute, it is very difficult for both parties to agree on one man to act as an arbitrator, so that some contracts provide for three arbitrators. Each party to the contract selects one man, and these two select the third arbitrator. In this case each party is more or less liable to choose a partisan to represent him, so that in the end it is often the decision of one arbitrator who decides upon the disputed point. The only difference is in the method of selection of the arbitrator.

Nearly every construction contract provides that the engineer

of the owner shall decide all disputed points and that his decision shall be accepted as final. This is an attempt to make him the arbitrator, but it is almost useless to state that this clause of a contract does not hold before the law. The engineer receiving his salary from one party to the contract is naturally supposed to protect his employer's interests, and he is hardly likely to make decisions that are entirely unbiased. There are, however, exceptions to every rule, and there have been cases where engineers have made decisions in favor of contractors when serious disputes arose. As a rule, engineers in charge of work cannot be arbitrators for controversies that arise.

Sometimes boards, made up of five or more members, are selected for arbitration. These boards sit very much as courts do and hear evidence and go over claims. They also visit the work. A weak point regarding courts is that court officers, such as judges and juries, seldom visit the site of work over which a lawsuit is brought. They must depend upon testimony, plans and photographs, which at times give confused ideas. Arbitrators by visiting the work have a great advantage over court officials.

Arbitrators are generally paid by the two parties of the contract, that is, the expense of arbitration is generally divided equally between the two parties. This is the wrong method in the author's opinion. All the cost of arbitration should be paid by that party who loses in the dispute. The innocent party should not be made to pay out a large sum of money to obtain his rights.

Some excellent results have been obtained by arbitration on construction work, and many written decisions have been made that should have been preserved for future use, as are decisions by the courts; but this is seldom done, as arbitration in the United States is without legal standing. The nearest thing that has legal standing, which approaches arbitration, is the United States Court of Claims and the various state courts of claims. In these courts, made up of several judges, strict legal procedure is not always followed, but the judges admit testimony and statements of fact in order to get at the truth, deciding afterward if such evidence shall be stricken from the record. These judges visit the scene of the work, take into consideration the local conditions and act very much as arbitrators, when considering a case.

Inasmuch as arbitration has no legal status in the United States, it is not binding on the parties of the contract. In other

words, after two parties have agreed to arbitrate, if one is dissatisfied in the award, that one can bring a suit at law. This makes arbitration a farce. In England arbitration is used in construction disputes, for the law recognizes it and places limitations upon arbitration. Engineers and contractors should endeavor to obtain laws in each state of the union giving legal status to arbitration.

In order to make arbitration effective, bonds are sometimes given by each party to the contract, which are forfeited when either party refuses to accept the report of the arbitrators. This does not always solve the problem, for the forfeited bond need not be paid without a suit, and this method sometimes results into two lawsuits instead of one.

The advantages of arbitration are many. Two out of three arbitrators are generally engineers or contractors, the third sometimes being a lawyer, and the opinion rendered is that of construction experts rather than a legal expert, as in case of a judge's decision.

By arbitration the disputes are generally decided quickly, hence large sums of money are not tied up for a long term of years. The witnesses are obtained before they are scattered over different sections of the country, as is the case with construction men when cases go to court. These men also testify when the facts are fresh in their minds instead of two or three years afterwards. It is also possible to see rock cuts and other features before they have been affected by the weather. Prices of materials and labor are a matter of record and are at hand.

In the state of New York and in other states, disputes regarding contracts are often referred by the courts to be heard by a referee, who afterwards makes a report to the court, subject to the court's reversion. This is an improvement over the court's hearing the case directly, but like a court of claims it is a slow process of settling suits and has all the delays of a modern lawsuit.

Any one having had experience with lawsuits can see the many advantages of arbitration, and will understand that it is much to be desired. Contractors should endeavor to have laws passed giving arbitration a legal standing.

### *Responsibility of Parties to a Contract.*

A contractor to obtain a contract must show his responsibility, both as a business man and a contractor. Furthermore, he must

furnish a bond; yet the contractor whenever he undertakes a new contract assumes certain risks and without any protection whatever. Mention has already been made as to how a contractor may be able to recover his money for public contracts. On private contracts the contractor, in addition, assumes the risk that the owner is not responsible. In justice to himself, the contractor should investigate carefully the financial condition of all parties with whom he contemplates making a contract. This should be done quietly without calling attention to it, as some competitor may use this fact to prevent him from obtaining the contract. In addition to reports received from banks and mercantile agencies, copies of underwriting agreements and contracts as to financial arrangements should be obtained, so as to learn at first hand who is to furnish the money and upon what terms and conditions. Should these things not be done, severe losses may be sustained.

# CHAPTER IV.

## THE BUSINESS END OF CONTRACTING.

### OBTAINING CONTRACTS.—THE SELLING END OF CONTRACTING.

IN ANY mercantile business the most important part is what is generally termed "the selling end." Without sales a business cannot live. It is very true that if materials for manufacturing or goods for sale are not purchased properly, the most competent salesman cannot make a business pay. If the manufacturing end of a business is not run properly, even should the selling end be efficient, the business cannot be made profitable, but almost any business man will tell you the hard part of his business is to keep his sales up to a standard and improve on it.

A contractor is to some extent a manufacturer and a seller of a certain class of goods. He is the builder or manufacturer of engineering structures. He is a buyer of materials, machinery and supplies, and these, with the aid of hired labor, are made into structures. A contractor does not have these completed structures for sale except in a few cases of some classes of buildings, but he is always anxious to sell his ability to construct them, and the organization that will produce any kind of an engineering structure for which he can contract. Thus there is a selling end to the contracting business, yet few contractors have conducted their business in the past as though this feature merited much consideration.

Very few contractors have ever advertised their business or attempted any systematic methods of obtaining contracts. The practice has been to give close attention to any contracts obtained, so as to do satisfactory work and make money on the job. Then, when new jobs were heard of, every effort was put forth to obtain some of them. These jobs are heard of either by chance or through the technical papers, or possibly through some reporting company. In most cases the contractors are unknown to the owners. On

public work this is seldom of importance but for private work it may mean much.

Most public work is advertised. Most of this advertising is through the local newspapers and the technical journals. The law governing public lettings generally provides that the contract must go to the lowest responsible bidder, or all bids must be rejected. Private contracts are seldom advertised and are let to any contractor whom the owner may select, but when several bids are received the work as a rule is awarded to the lowest bidder.

Many private corporations keep lists of contractors, from whom they ask bids. Others, who may not do much construction, make up special lists from whom bids are asked, or they allow any contractor asking permission to estimate, to submit a proposal. Some few corporations call in a contractor and by a simple agreement as to general terms and prices, allow the contractor to do their work. Some contractors seem to secure a large number of contracts by these haphazard methods, but many are frequently out of work or seldom have more than one job on hand.

There should be few contractors who cannot carry on more than one job. Even if their capital is limited, it is possible to do several jobs at one time, as every contract obtained is an additional asset. Thus it is seen that most contractors pay but little attention to the selling end of contracting. There is no reason why it should not be considered as much as the operating part of contracting.

There are several ways that a department organized for this purpose could obtain results. First, all information gathered from the various technical and contractors' papers could be indexed and followed up by letters and personal calls. Then a judicious campaign of advertising could be carried on. Advertisements could be placed in the engineering and contractors' papers and also in the daily papers when work is to be confined to given localities. In such advertisements, just to publish the company's name and address with a photograph of some work done will hardly do much good. Tell something of the contracting company, the class of work they do, the fact that contracts are finished without disputes, and that they are completed on time. Show how money has been saved to clients. If certain classes of work are made a specialty, enlarge on the ability to do this work better than other contractors. If a certain form of contract is used, explain it and its merits. From time to time give lists of various contracts satisfactorily com-

pleted. In other words, say something in the "ads" that will attract special attention to the company. It may not be possible to trace direct results to all such "ads" but the publicity will make the company well known and materially assist in landing contracts.

Another method of advertising is to issue attractively gotten up books or pamphlets, well illustrated, descriptive of work done in the past. These can be distributed among engineers and owners, who may have construction work to do.

A third method of advertising is to send circulars through the mail to those who may have jobs to let. This, if consistently followed up, brings returns.

Another method, used by an eastern contractor, is to employ a man who is really his solicitor. This man keeps posted on work to be let and keeps in touch by correspondence and personal calls on all officials and owners who have to do with the letting of work. He need not be an engineer or have had experience as a contractor, although both of these are to be preferred, but he should be a man of attractive appearance, able to put up a good sensible talk on construction work, and he should have the ability to impress those to whom he is talking.

This solicitor has nothing to do except to obtain work, and he is paid a drawing account and a commission on the profit made, on all jobs he obtains. This method is proving a success and jobs have been obtained that would not otherwise have been heard of by the contractor. This contractor has his construction department, his engineering department (which has charge of all estimating and engineering work), his financial department and his selling department. This forms a well balanced organization, and the contractor is becoming one of the best known men in his line of work in his locality.

Some contractors show marked ability in obtaining work and much of their success at contracting depends upon this. Naturally a contractor cannot make money unless he obtains contracts, and on the proper basis. This is really the selling end of contracting. It should be as well organized and thought out as the operating part of the business.

On public work the personality of the contractor can be made a factor in obtaining work, but in most cases work must be awarded to the lowest bidder, although in some sections awarding boards now have authority to give contracts to those they believe will best

serve the interest of the public, irrespective of whether they are the lowest bidders or not. Acquaintance with engineers and officials can become an asset, and in private work this is especially so.

### *Politicians as Contractors.*

In public work some contractors can obtain jobs at much better prices than others, but they may not have the ability to carry on the construction work as well. Politicians are sometimes made members of contracting firms with a view of obtaining new work through them. This practice is to be condemned in most cases.

A politician going into contracting should give up politics, and when a contractor enters politics he should no longer bid on public work, restricting himself, if he continues at contracting, to private work. It is possible to do this, as the author knows of a prominent contractor of the east, who has considerable influence in the politics of his state, who always takes an active part in every campaign, especially one for public improvements, yet he absolutely refuses to accept a public office, or bid on any public work. Few politicians, however, are like this man.

When politicians are interested in contracts there is always a suspicion of graft, and when a contractor sells or gives an interest in his business to a politician, this suspicion becomes more real, as the sole reason for bringing in the politician is to obtain his influence in securing contracts, and in seeing that they are carried out under the most favorable conditions. In other words the politician is considered a "friend at court" and but for the possible help of this kind he can give, he would not be wanted.

The worst evil of this kind is when a powerful politician or boss is a silent partner not only of one contractor, but of several. Then work to be done by the government controlled by the boss is all arranged for award before bids are received, and prices are fixed in every case. In this way the whole system of contracting becomes corrupt, not only in the letting but also in the carrying out of the contracts. Frequently inspectors are corrupted and even engineers, and the tax-payers are fleeced of their money.

A clique of contractors is thus formed, and it is almost impossible for an outsider to obtain any work by bidding, and other contractors soon learn it is wasting both time and money to make proposals, where these conditions exist. It is difficult to prevent

such things by law (although office holders should be prevented from being interested in contracts), so the only way that such things can be suppressed is by contractors themselves.

Whether the work is to be public or private, the contractors or those who bid for them, should be accustomed to make deals and to handle business men in a diplomatic manner. They should be quick at sizing up men, be good talkers, yet have the ability to make other people talk, and be good listeners. They should have a retentive memory so that they can make notes of conversations after they have occurred, as it is not always good policy to make memoranda while the conversation is going on. They should be able to size up conditions quickly, observe facts, make deductions, and carry general plans in their minds with all facts, figures and other thinks that may affect the price of the work and the method of carrying it on. When two men are discussing any matter on which a deal is to be made, the one likely to obtain the better side will be the better posted one.

### *Scope of Operations.*

In obtaining work, one governing factor will be the scope of operation a contractor can cover. First comes the form of contract under which he is willing to work. This limits the scope of a contractor's work. If he takes work upon a percentage basis or on the cost plus a fixed sum plan or some similar method, then he is prevented from obtaining public contracts, as they are never let in this manner. A contractor doing work under such forms of contract, if he is honest and wishes to be sincere with his customers, cannot accept lump sum or unit price contracts. One prominent contractor who has made a specialty of doing business under the "cost plus a fixed sum method" said: "At first I took contracts under the cost plus a fixed sum form and at the same time lump sum and unit prices, and although I tried to do justice to the first contracts I found myself sending my best men and tools and machinery to the job where my profit could be increased and the cost plus a fixed sum contracts suffered, so I decided that if I was to continue under the last named form of contract I must give up all others." This he did.

This illustrates how a man's scope can be limited by the form of contract he is willing to work under. When any form of a per-

centage contract is used, then public contracts cannot be obtained and not only is the contractor limited to private contracts but also to those where the owner is first convinced that such a form of contract is to his advantage. Most owners, however, seem to think that lump sum or unit price contracts are more desirable.

The next factor in the scope of operation is to the class of construction that a contractor places limitations upon. The first great division or distinction, is buildings from other classes of construction. Erecting buildings might be termed "architectural contracting" in distinction from "engineering contracting." Some contractors limit their field of work to buildings, and in many towns and cities this kind of contracting has been emphasized as the "building trade." It has also grown to be a distinct branch of contracting, and frequently contractors, who confine their operations to this field are called "builders." Some of the largest contractors in the country who do this class of work also do general contracting, that is, any class of engineering construction, and this fact coupled with engineering contractors, who during the last decade have turned their attentions to concrete building constructions, is breaking up any division between architectural and engineering contracting.

Many contractors limit their operations to sub-contracting work on buildings, such as carpenter work, brick laying, plumbing, plastering, metal work, electrical fixtures, and many other classes of construction. In some sections of the country these various sub-contractors are considered trades people, instead of contractors, but inasmuch as they all name prices for their work and enter into contracts for it, they must be considered contractors.

Some building contractors specialize, that is, some confine their work to factories and warehouses, others to office buildings, some to residences, some to churches and others to public buildings. Many will construct any kind of building for which they can obtain a contract.

In some cases contractors limit their work to certain materials, such as steel, concrete, earth and rock, masonry, timber or wood work, the installation of machinery and other lines.

Some contractors narrow the scope of their operations to difficult and hazardous undertakings. In other words they become specialists in these lines and are thus enabled to keep a corps of men who are trained for such work. Some classes of work of this

kind are foundations, subaqueous work, such as tunnels and pipes under water, bridge piers, and similar structures. Docks, piers and dredging seem to be work that go together and many contractors do this exclusively. Some even confine their work to dredging.

On land we find contractors who build bridges, others railroads, others wagon roads, some sewers, some street paving and sidewalk work, some power dams, others do waterwork construction, such as reservoirs, aqueducts, pipe laying, stand pipes and similar structures. Occasionally we find contractors who confine their work to shaft sinking and tunnel construction. Then some contractors specialize on electrical work, as telephone and telegraph lines, transmission lines, trolley roads and such classes of work.

There are a large number of contractors who do any kind of construction work and under any form of contract and undertake both private and public contracts. Some firms will undertake contracts to build an entire manufacturing town, build the railroad to it, construct a dam for power purposes, build the factories and warehouses, the dwellings of the officials, laborers' houses, store buildings and public halls, electric lighting, water supply and sewerage systems, and all the details that go to make up a new town or city.

There are many opinions as to the scope of work a contractor should undertake. This alone is shown by the various lines followed as just outlined. Some engineers and contractors claim it is well to specialize, and become experts in certain lines, others believe in covering several lines of similar work or else work that goes hand in hand, and many believe in doing a very general line of work.

Personally the author is of the opinion that the general and diversified work is the best to follow. More work can be obtained, a wider experience is gained, and in hard or stringent times, when specialists are idle, the general contractor is able to keep his outfits and forces at work, without having to enter new and untried fields. The opportunity of making money is as great if not greater, than only following one line or kind of work.

### *Territory of Operation.*

Next to the scope of work that a contractor will do, comes the territory over which he operates. Contractors differ much in their opinions as to this. Some confine their operations to one large city

and its immediate vicinity, others to the largest cities of the country, some to several states near their home offices, while some will work in a certain section of the country, as eastern Canada or the New England states; again some limit their territory to the north, others to the south, others to the middle west and some to the far west. Occasionally contractors are found who will not go more than fifty to one hundred miles from their homes, even limiting the territory in which they do work to one or two counties of their state.

On the other hand, there are some contractors who will go anywhere in their own countries, as an American will do work in any or all parts of the United States, and Canadians who operate all over Canada. Then we find Americans who make a specialty of doing work in Mexico, while others confine their work to Central and South America. There are some few contractors who will not do work in the states, but will undertake contracts in any foreign land. Then we find some American and European firms who do work in any part of the world.

Various arguments are assigned for limiting the territory of operation, and at the same time excellent reasons are set forth for making the world a contractor's field, but at the best, many contractors are always moving from one section to another, from one country to another, and some within a decade have circled the globe.

By doing this, work is done under wider varying conditions, and in order to make a success, contractors should be close students of people and countries, quick to size up local conditions and make correct deductions.

### *Practical Geology.*

Contractors should know the practical side of geology. Work in a country where there has been glacial action is decidedly different from those sections that have never been visited by glaciers. Likewise countries that have experienced volcanic action, even though the volcanoes are now extinct, present unusual construction problems. Geological faults change the character of the timber in a country and likewise the soil, thus materially changing the excavation work. The aggregate used for concrete, changes in different sections of the United States and also in the world, due to a great extent to geology. Weather conditions likewise vary in the geology of a country. This affects streams that may have much to do with

a contractor's work. The bottom of streams is especially affected by the geological conditions. Practical geology affects nearly all kinds of construction work. Even street paving and surface road work is affected in this way. The high class of oil tamped roads in California have not been duplicated in the east, owing to the soil and climatic conditions.

Many of the contractors moving from one section of the country to another to do work have lost money owing to the fact that they have not studied these facts and taken them into consideration. Some engineers and contractors feel that the study of geology is beneath them, and say that a knowledge of it is not necessary. The National government had extensive geological studies made at Panama, so as to guide the engineers in their designing and construction work on the Isthmus in building the canal. The Board of Water Supply of New York City, building the Catskill water system has done likewise, and much money was saved, both to the city and to contractors.

*Reputation of Contractors.*

A factor that governs obtaining work is the reputation of the contractor. This applies to individuals, firms and corporations. Experience is part of a contractor's reputation, for he gains his reputation as he gains experience. Every beginner is bound to lack experience, but as many contractors first work as engineers, timekeepers, foremen, superintendents and in similar positions on construction work, they have some years of experience before beginning as contractors. A broad experience in construction is a large asset, and is absolutely needed, but some owners and engineers insist on contractors having had special experience on the particular line of work upon which they are making proposals.

It is but natural that any one should want an experienced man to do his work, but if this rule is literally carried out, how is a contractor to obtain his first job? Bids may be asked for some waterworks construction, such as a reservoir or an aqueduct or a pipe line. Must the contractor have carried on considerable of this work in order to qualify? This is hardly necessary. The answer is, if a reservoir is to be built and the structure is entirely of reinforced concrete, any contractor experienced in concrete work, whether it has been for buildings, retaining walls, arches or other work, is competent to build the reservoir. If the structure is of

stone masonry, then a good masonry contractor should do satisfactory work. If earth embankments are to be built, a man having done excavation on a large scale and built embankments should be qualified to construct the reservoir even if he has never built a reservoir.

A notable incident in this connection occurred a few years ago when a large contracting firm was refused a piece of work for lack of experience in that class of construction, by a board of engineers, two of the four engineers being entirely without practical experience in building such a structure, and the third one's experience had been limited to small structures of that kind. Only one engineer had extensive experience. It is a poor rule that will not work both ways. If the contractor was not competent to have the work, then three of these engineers were hardly competent to fill their positions. They condemned a contractor for not having the very experience that they themselves lacked.

These engineers were competent men, and capable of filling their positions in a more acceptable manner than many other men would have been and any contractor, experienced in general construction work, is capable of building any structure or class of work, if furnished with the proper plans and specifications, and if competent engineers are in charge of the work.

There are a few hazardous kinds of construction that some contractors have found it advantageous to specialize on, and in such cases it is well to employ these firms, but this does not mean that others could not do the work as well.

Reliability and responsibility are always specified in public contracts. The laws governing the letting of contracts often read that contracts must be "let to the lowest responsible bidder." This is generally taken to mean that the bidder must put up a certified check, not necessarily his own, and must make the necessary bond. At times, however, his financial responsibility is looked into, as well as the manner of carrying on former contracts.

The author knows one case where a contract for a reservoir was not awarded to a contractor because on a previous job for the same class of work this contractor had put a large number of empty cement barrels in an earthen dyke. The awarding board's decision was carried into the courts by the contractor, and the courts decided that a contractor who resorted to such practices was not reliable.

Ability is a varying quantity with an individual, firm or corporation. Ability is the keynote to success. Many contractors could make public all their cost records, their methods of doing work, and their system of accounting and carrying on their job. Yet their competitors, with the knowledge thus obtained, might fail to achieve the same success, due to a lack of ability. A man, firm, or corporation of marked ability will always be well advertised and will always achieve success. Carnegie had many able assistants, but it was his marked ability that made his company the most influential in the steel industry Rockefeller, by his superior ability, made the Standard Oil Company the greatest of modern commercial corporations. Examples could also be cited in the contracting field.

A man of ability will realize that a reputation for good work is a valuable asset. To use a common term, "skinning work" will injure a contractor. Everyone wants value for the money expended. It is possible to skimp some work without affecting its quality, but a contractor who follows specifications and plans will win more in the end than the one who believes he can fool the engineers. The belief that contractors, as a class, are dishonest, has been caused by some contractors believing that they could make more money by ignoring specifications and skinning and skimping their work. It is the old proverb brought home again, "Honesty is the best policy." With honest work done by all, inspectors would soon lose their jobs; but from present indications inspectors need not worry about this matter.

The speed of carrying out contracts is an important consideration to all who have construction work to do. A contractor who gains a reputation for finishing contracts on time has a valuable asset in obtaining work, both public and private, and especially the latter. To further increase the speed of work, so as to finish ahead of the contract time, and to cut off a number of months, gives to a contractor an additional lever in securing other work.

On one occasion the author, in bidding on a job on which fourteen months' finish was asked by the company's engineer, suggested to the president of the company that the contractor, with whom the author was associated, could do the work within nine months, so the offer was made to make it a bonus and profit job on such a basis. This offer practically landed the work, and the job was finished so as to earn six days' bonus.

Men who are contentious frequently have a hard time in carrying out contracts, and lawsuits are generally brought by such men. A reputation of this kind is an injury. One of the largest contractors in the world is proud of his record in this particular. He has never brought a lawsuit against an owner.

### *Capital Needed.*

The amount of capital that a contractor has plays an important part in obtaining and handling work. Few contractors will agree on the exact amount needed for any certain job. But with small capital, only small jobs can be handled and only a few jobs at a time, while with a larger amount of capital many big undertakings can be carried on at the same time.

Some contractors, either by means of their own capital, or by connections with banking interests, are able to promote and finance construction jobs. This is a good line of business, but it should be handled with great care, as many contractors have come to grief in undertakings of this character. Once established, the business is a profitable one, as a profit can be made on the construction work, and also in providing the money and in operating the property.

### *Contractors' Estimates.*

The actual work of estimating upon new jobs is always impressive, and is considered by every engineer and contractor as an undertaking not only of importance, but of great difficulty. To some extent it can be likened to a throw of the dice. Is the throw to land the prize or not; and if it is landed, is it to be a profitable one or not; that is, does it mean to win or to lose? In past days contracting was a business, or we may even say, a game of chance. It was a matter of playing for large stakes, with a possible chance of winning and a greater chance of losing. But conditions have changed, although many banks and business men still look upon contracting as hazardous, with the chances against making money.

### *Conditions Affecting Contracts.*

Contracting has been hazardous, as nearly all conditions have been against contractors, but things have changed and are still

changing rapidly, so that the contractor is able to do business on a better basis.

Laws and business customs have been unfavorable to contractors. The common English laws followed in America have to some extent given protection to contractors and their workmen when engaged in building houses or boats, but in most engineering undertakings the legal status of the contractor has been uncertain and that of the sub-contractor even worse. Within recent years laws have been enacted and broad rulings of the courts have been rendered that have bettered the standing of contractors and sub-contractors, and even material men are now protected to some extent. On public work the standing of contractors has likewise improved, so that the burden of responsibility is not as great as it once was.

During the past decade there has been a decided agitation among engineers, architects and contractors to improve the forms of contracts used and to secure more equitable and practical specifications, and this has been productive of good results. Today contracts and specifications are much fairer and broader than they formerly were.

Engineers and contractors have also been made to realize the value of the costs of construction. Both in estimating and in carrying on construction, methods and costs are taken into consideration, so that a better understanding now exists between engineers and contractors as to the difficulties to be overcome in construction work; and the relations between engineers and contractors are closer and better understood.

The economics of contracting are being studied and considered in construction work. This, with scientific management, is increasing the efficiency of men and machines so that the basis of estimating upon work and carrying it on is nearly upon a scientific basis.

### *Estimating by Guessing.*

Less than a decade ago estimates of costs both by engineers and contractors were generally mere guesses. They were not called guesses, for those making them, on being asked to explain their estimates, would state that their long and broad experience enabled them at a glance, after seeing plans, specifications, etc., and looking over the site of the work, to name a price on any

class of work. Many of them, on finding after the work was finished that their guess or estimate was a poor one, stated that they had forgotten to multiply their bid prices by two.

Some contractors still follow this method, believing that it is beneath them to analyze their costs. Such men will not last long in the profession. There is good reason for believing that contracting is less hazardous than formerly, and that with proper management and method of estimating the day will come when contracting will be just as safe a business as any in which there is a large amount of labor employed, this being always the uncertain element of cost.

Every engineer and contractor has a slightly different method of making up estimates of costs; but in the main and in important details they are similar, when the various items are analyzed and the estimates made up from cost synthesis. Take, for instance, any item, as excavating a cubic yard of earth with a steam shovel. Today an analysis of the various items that go to make up this cost is made, while the former method was to guess at the entire cost in a lump. However, there is still some diversity of opinion as to this method of estimating. One prominent engineer is reported to have said:

"I never analyze cost; I never do it in that form; I do not believe that is the proper way to make an estimate; I think it only leads to confusion and erroneous conclusions."

### *Estimating by Analysis.*

Another well-known engineer states:

"Practically, in my judgment, there is absolutely no way of making a reliable estimate of the cost of doing a particular work except by cutting it up into its ultimate elements, and making estimates of each in turn, based upon a number of other cost analyses of work that come near coinciding in these particular elements. Any one who says he can make an estimate by any other method, if tested in a particular case, will find himself letting go of his general estimate and getting into a detailed analysis of the various elements."

For example, any one estimating the cost of concrete per cubic yard can obtain prices from dealers on the aggregate, sand, cement, steel and lumber. The exact amount of each material

needed for a cubic yard can be calculated and so set down without any guessing. Then only two items, the cost of mixing and placing and the cost of erecting and tearing down forms, mostly items of labor, must be estimated. From records and other experiences these two items can be estimated and allowances made for plant and general expense charges, and a fairly accurate estimate made. This is certainly better than a "scientific guess" at the total cost of the units of work, and it eliminates a large allowance for contingencies.

This method reduces guessing to a minimum, and instead of a guess in lumps, what little must be done is confined to a few items, which are generally a small per cent of the total. Those who follow this method and do much estimating will soon learn the various man and machine units of work per hour or per day, so that the only uncertain phase of labor costs will be the fluctuation of wages.

*Contingencies.*

There is really no class of work done on engineering jobs that cannot be divided into many items for estimating. There are a few kinds of work, though, that are always more or less uncertain, as pumping and bailing in connection with cofferdams and other foundation work. Here some contractors estimate liberally for contingencies. It may be well under such circumstances to make an allowance for contingencies, but this practice is generally to be condemned. Contingencies should be ignored, as they have gotten many engineers and contractors into trouble. Contingencies mean ignorance, and every engineer and contractor should know every detail of his work. Even as difficult a problem as pumping, the cost per thousand gallons or million gallons, can be calculated, and the approximate quantity of water to be pumped can be estimated or the cost can be calculated as the basis of a pump hour. Thus, the item of contingencies even for such work can be ignored, as the approximate cost can be made to cover the work as well as by a percentage for contingencies.

The "scientific guess" method based on a "long experience" is impressive to the layman; but it shows inexperience and is the lazy man's way of estimating. To break up the various items into their component parts and to use cost analysis can only be done successfully by an experienced estimator (the inexperienced

had better stick to his "guess"), and the operation is one of great labor. But it is well repaid, as in this manner another element of luck is eliminated from contracting.

### *Form of Contract Affects Estimates.*

Contractors in making estimates for proposals must vary somewhat according to the contract form under which the work is to be done. On a cost plus fixed sum basis or on a percentage basis, he must do this for two reasons: first, so that the owner will provide ample funds for the work; second, so that the owner will know the maximum amount he must pay as a fixed sum or percentage. Then, if the contractor, through efficient management or by other means, is able to save money on the estimated cost he pleases the owner and earns a reputation as a competent constructor. To many owners this is seemingly a satisfactory method of doing work, especially on buildings; but this is due to a lack of general knowledge on the subject.

### *Lump Sum Estimates.*

When the form of contract calls for a lump sum bid a contractor must estimate safe; that is, he must have a price that will cover small changes, so that it will not be necessary to make claims for all kinds of extras. He should carefully check all the items of work to be done, and see that there is ample protection for himself. The cost on this basis is seldom as great to the owner as with the percentage basis, nor is there the same chance to make a "grand stand" play on reducing the cost. All these forms of contract permit of loose and inefficient methods of estimating. Percentages are generally added to cover up short estimates of quantities, and for possible changes, and other uncertain features.

### *Unit Price Estimates.*

All of this is unnecessary when work is let on unit prices. When a price is obtained for every class of work that is likely to occur, then if the quality of each class has been properly estimated by or for the owner, the total cost of the work is readily obtained. There are no uncertain things for the contractor to

figure upon. This form of contract gives him the best results and at the same time the owner is not overcharged. With the proper provision thrown around the bidding the contract prices are not likely to be unbalanced. This means careful estimating and a great deal of labor for both the engineer and the contractor.

### *Conditions That Make High Estimates.*

Only one other feature in contracts needs to be considered. Maintenance and guarantee clauses must necessarily add to the contract price, even though additional work may not be needed. The chance of repairs, or even of part renewal, is there, and the contractor must add a percentage for this. One reason for poor pavements in our city streets is the maintenance and guarantee clause in paving contracts.

There are other things, and occasionally conditions arise that compel contractors to add to their bidding price. In one eastern city the sewer contractors have learned that the engineers in charge of the work make so many errors in laying down the grades of the sewers that they are compelled to change some of the work, adding to their costs. To offset this they are today bidding 20 per cent higher than formerly on all sewer work.

The writer knows several engineers who make such arbitrary rulings regarding their work and the specifications, that it is necessary to add a percentage to the prices to offset the cost thus added. For one man, about 10 per cent cares for this increase, while in another case 15 per cent must be added.

This calls attention to the effect of engineers on contractors' work and prices. A young, inexperienced engineer, impressed with his own importance, or a crabbed man of mature years will always make a contractor's work much harder and may add much to the cost. These things, if possible, should be ascertained and considered before making an estimate.

Other things must also be considered. The ordinary percentage retained on a job is 10 per cent. With this, and figuring 15 per cent profit, with monthly payments, a margin of 5 per cent profit can be made, so that the job can earn the money necessary to run it each month; but if a larger per cent is retained, as 15, 20 or 25 per cent, then the money received in monthly estimates will not run the job and a much larger capital must be employed.

This is also the case when payments are made quarterly or at the end of the job, or when assessments, levies, bonds or other certificates of indebtedness are given in part payment of the work.

The condition of the labor market may add materially to the cost of the work. Men may be plentiful when a job starts, but wages may increase and laborers become difficult to obtain, due sometimes to the magnitude of the job undertaken, or by other work being started in the same locality, or even by business conditions becoming exceptionally good. Labor unions sometimes bring about these conditions and are responsible for increasing a contractor's cost.

Local laws as to the handling of explosives, the inspection of machinery, the burning of soft coal, the paying for water used, and similar things, should all be considered in making up estimates. The rules of labor unions regarding the work a man may do may also affect a contractor's work, and these things must be known and considered in estimating.

### *Prices for Materials.*

In the case of materials, either for consumption or to become a part of the structure, there should never be any guesswork as to their cost. Before bidding upon a job, prices of all materials, based on the approximate amount needed, should be obtained in writing from responsible dealers. When it is necessary to obtain such quotations either by telegraph or telephone each dealer should be asked to confirm his quoted prices by letter. If, within a reasonable time, these prices are accepted, a contract is thus made for materials. Those quotations that are not used should be acknowledged and the merchants advised that their prices cannot be accepted upon this occasion. In this manner a contractor is protected in purchasing materials, and also in not buying from those who have named an excessive price. In order to have a clear understanding on furnishing materials, the approximate amounts should be furnished to the dealers, and in some cases it is advisable after the job is obtained to draw up a formal contract with the supply men. The approximate amount of material is then stated and the phrase "more or less" should be used as a protection to the contractor; otherwise he may be compelled by the dealer to buy more than is actually needed for the job.

*Estimate Forms.*

In making up an estimate the plans and specifications should first be gone over carefully and then referred to as needed from time to time. Forms should be gotten up for the purpose, and the various items of work should be outlined with the factors of cost all set down on these forms. In this manner nothing will be forgotten and the estimate, when completed, will be handy for easy reference at any time. From these sheets the bidding prices can be made and entered on the proposal form.

If all the items and component parts are listed, and the cost of each set forth on these sheets, then it is possible to use these estimate sheets as a standard for the work, to determine wastes both of materials and labor.

For this reason, sketches or drawings of form work for concrete, tunnel or trench bracing, temporary trestles, arrangement of plant and other notes should be made on these estimate sheets, or attached sheets, with reference numbers. These things are seldom done, and for this reason money that should be cleared as profit on a job, is often lost. Only recently an engineer for a contracting company told the author that in estimating on concrete buildings and bridges he always devised a system of forms; but that if the company obtained the contract the superintendent devised his own system of forms, without reference to those on which the estimate was based. This is a common occurrence. The result is that if the superintendent's forms are more expensive, money is lost to the company, while if they are cheaper, the engineer's estimates are too high and jobs are lost. One contractor has rectified this by having his system of forms in chart and book form, and all ordinary construction, both as to estimating and bidding, are carried out on the system furnished. This method also permits improvements to be made, to the benefit of contractor and clients.

Another reason for making note of these things and using drawings and sketches is that memory fails all of us at times, and to depend on one's memory often means loss of money.

Both engineers and contractors should make estimates in the same general manner, but engineers can use published cost data both for checking and making estimates to a greater extent than contractors.

*Relation of Engineers and Contractors.*

Like the definition of engineering, the relation between an engineer and a contractor should be ideal; yet it seldom is, in spite of the fact that they are co-workers and both are employed by the same party. The American engineers and contractors are very closely associated, and today, when many contractors are also engineers, and our large contracting firms and corporations employ large numbers of engineers, the bond should be strong between the two professions. Unfortunately, it is not; yet during the past five years a decided advance has been made in this connection, and a much better understanding has resulted.

Ten or fifteen years ago engineers and contractors looked upon each other as natural enemies, with the contractor in the role of the under-dog in the fight, while construction was going on. And the engineer was like a poor relation, almost a penniless outcast, after the job was finished, and until he could obtain a new position.

The writer once heard an engineer express the opinion that he believed the majority of contractors to be dishonest. One man's opinion does not make a thing so, but it does injury. Such opinions are more or less likely to be based upon inexperience or upon one very sad experience. This opinion illustrates that there is an antipathy existing between engineers and contractors, in spite of the fact that they should be friends. Each is necessary to the other, the engineer being the designer, the contractor the builder of his designs. Their work goes hand in hand, and with a friendly feeling existing it can be done more expeditiously and economically. Engineers and contractors together make up one machine, carrying out the plans and ideas of capitalists. Lack of co-operation results in inefficiency. Who is injured in reputation and in business by such conditions? Seldom the engineer, for he can make his reputation secure. His story is generally the first one heard and he does not have his money at stake. The contractor, on the other hand, has all his earnings invested in his work, as well as his reputation as a contractor and business man, and it is possible for him to lose both his money and his reputation as a contractor. The contractor therefore is the one who suffers both before the general public and with those who employ him. A further evidence that contractors are injured by the feeling that

exists against them is the cry of the politicians and city officials who, in catering to the public, have declared themselves against city work done by the contractor, and have advocated the expensive and demoralizing day labor method. The prejudice of the public, due to ignorance, is an injury to the contracting business, it being sometimes charged that the contractor's profits are a form of graft.

### *The Powers of an Engineer.*

The position of an engineer in charge of construction work is not analogous to that of any other position. He is an employee; that is, he is generally employed on a salary and not on a commission basis, as an architect is, although some few engineers are so employed. The engineer is called upon to make surveys, estimates and designs, then to draw specifications and forms of contract, and to let the work. Representing the owner, he has the contractor's work to supervise, and under the specifications he is the referee and arbitrator between the owner and the contractor. It is his duty to interpret the specifications and clauses of the contract, to classify the work and make estimates for payments, to settle disputes, and to give a final certificate of approval and acceptance of the work when the job is completed.

The engineer, although employed by one party of the contract, is supposed to be unbiased, without favor or prejudice to either party. His powers, without the right of appeal from his decisions, really make of him a czar on the job, and he has power not only to make or break the contractor, but also to ruin the owner, should he prove to be either incompetent or unscrupulous. His position is one of unusual responsibility, much greater than that of the president of the company. The lives of many people are in his hands, as he must anticipate the action of storm and flood, fire and earthquake and other conditions of which the layman seldom thinks. And what is his compensation for this work and the great responsibility?—a meager salary, in some cases not as large as some of the mechanics who are working on the same job. The salaries paid engineers are in many cases ridiculous, as there are many men having fewer responsibilities and not as onerous work who receive far greater recompense. But this is another subject. A broad minded and evenly balanced man might act in the dual position of agent for the owner, and referee or judge between his

employer and the contractor, and render fair and unbiased decisions; but this has been the exception rather than the rule in the past, with the result that engineers and contractors have been antagonistic to each other.

Within the past decade conditions in these things have materially improved. There has been an awakened interest of both engineers and contractors in each other's work. The engineer has been keen to learn the viewpoint of the contractor, and to learn the contractor's troubles; while the contractor has realized that the engineer, too, has his troubles, but that he is willing to meet the contractor half way in a fair proposition. In other words, the engineer and contractor are beginning to understand one another. These results have been accomplished through the fact that today we have a literature dealing with contracting which is rapidly growing, while formerly only the engineer's work was known or written about, even in the technical journals. We also have contractors' meetings for discussing the various subjects that interest them.

### *Contractor's Engineer.*

The question is sometimes asked, should a contractor or firm of contractors employ engineers to assist in carrying out their contracts? No matter what may be the character of the construction a firm may be engaged upon, or the size of the job, an engineer's services will be found useful, and if the engineer so employed realizes the opportunity presented to him, he can on any job effect such savings and so assist in the work as to more than save to his employer the salary paid him, no matter whether it is large or small. These are facts based upon actual experience in this class of engineering work.

Some contractors believe otherwise. The author remembers discussing this subject with the president of a large construction company, operating in the south, who was asked if he employed engineers. His reply was that he saw little use for them, as the railroad companies for whom he worked furnished engineers to look after the construction, and that any work he might wish done in his camps or offices could be done by other employees, who were paid smaller salaries than engineers command. He further stated that the railroad company's engineers might look on engineers in his employ as being there to keep tab on them, and in this

manner and other ways, certain friction might spring up between his company and the railroad employees.

It is needless to say the view of this contractor was based on wrong assumptions. In the first place, every engineer employed by the owner will not object to having his work checked by another man, and if it is checked he will be pleased that it is an engineer who is doing the work, and under most circumstances the owner's engineer will assist in every possible manner. The author's experience as a contractor's engineer is that the engineers for the owner sometimes insisted that their work be checked by him. But this is not the work of a contractor's engineer. He may seldom be called upon to check up the work of the engineer to the other party of the contract, although it is a fact that the contractor's engineer and the engineer of the railroad company can be of vast assistance to each other in many ways.

The owner does not employ his engineers to look after the interests of the contractor, except in an indirect manner. They are supposed to be fair and considerate of the contractor and to supervise the construction; but the contractor's interests at any time may be exactly opposite to those of the owner, and when the services of an engineer are then needed by a contractor he cannot depend upon those of the other party. He must have his own engineers, and they should be familiar with the work from start to finish, and not be called in for the occasion.

The idea that certain work can be done by poorly paid men is a common fallacy in the business world. It is the man of ability, who commands a good salary, who obtains the greatest results in all work. Money can be lost, of which a reckoning cannot be made, when cheap men are employed.

Many contractors look upon engineers as unpractical men, and as not suited for contract work, believing that they are theoretical men and that it is impossible for them to make a success at contracting. This is an erroneous idea, for many engineers have become successful contractors. Of course, some competent engineers may not make good contractors, just as other men will fail in some lines and achieve success in others.

There are certain essentials that must be recognized by both the contractor and the engineer, when the latter accepts employment with a contractor. The engineer must not be looked upon as a luxury in the business, nor be considered as a man of theory

without practical experience in business. Instead, the contractor should realize that the engineer can be useful to him and he must show that he has confidence in him. He should tell the engineer of his plans and resources for carrying on his jobs, and treat him in all ways as he would the superintendent of his work. Nearly every contractor realizes that his superintendent must know nearly as much regarding the details of his business and financial standing, to obtain the best results, as the contractor does, and if the engineer is to serve him well he must accord to him similar treatment and confidence. If he cannot do this it were better not to employ him.

The engineer should bear in mind that although his employer may not be a technically educated man, and may possibly have had poor schooling, his experience as a business man and in the contracting and construction field, extending, perhaps, over a long term of years, may have so educated him, as to make of him a contracting engineer of no mean ability. The fact is that some contractors possess exceptional engineering ability. Consequently the engineer should look upon his employer as a brother engineer. He should give similar consideration to the superintendent or general manager, and even to the foremen employed on the various jobs. Many an engineer has gleaned valuable information from such sources.

The author knew a superintendent some years ago, before the days of cost keeping and scientific management and when there was absolutely nothing in print on the subject of outputs of men and machines on construction work, who was a regular storehouse of such information. His advice on such matters was invaluable and no one could be associated with him without learning much. He had been raised as a young man on a farm and had only a common country school education. But starting as a foreman he had worked his way up quickly, owing to the minute study he had made of the work he did. It is to be regretted that the allurement of the farm took him from the contracting field.

### *Engineer's Duties.*

An engineer working for a contractor should study the job upon which he is engaged in a most thorough manner, in some respects in closer detail than if he were the designing engineer.

He should tabulate all data about the job, and have it for ready reference. He should know in detail the distribution of all excavated material, and as far as possible the classification that it is likely to carry. Waste banks should be selected and borrow pits located in advance of doing the work, if possible even before bidding on the job. Wagon roads, crossings and roads adjoining the work should be studied and their grades and conditions noted. Quarries and timber supplies should be hunted up. Those selected for use should be certain to pass the specifications and at the same time they should be the ones that can be worked at the least cost. The daily and weekly market reports must be watched for the prices of materials, and purchases made when they are most favorable. The contractor's engineer should have charge of the buying, even if he is not the actual purchasing agent; that is, if he is too busy to do the buying, the buying should be under his charge. The purchasing of materials, supplies and machinery is one of vast importance, and an engineer can effect great savings if he gives this matter the proper study.

Camp sites, easy of access to the work, and points for receiving and furnishing supplies, should be selected, and every condition that will affect the cost of the work should be studied; and notes should be made as to whether such conditions will reduce the cost of the work, or add to it. Economical designs for centers for masonry and forms for concrete must be gotten up for many jobs, as well as the designs for temporary trestles, camps and similar structures. As far as possible such plans should be standard, but there are occasions when the standard plans will not be economical.

The work itself should be planned and a general layout for every job should be mapped out so that the various officials can understand how every detail of the work is to be handled. A study should be made of all kinds of machines and labor saving devices, so that those best fitted for the work in hand can be bought and installed. The engineer should keep posted on every new invention and method of doing work, so as to adopt them in his employer's business whenever a saving can be effected. At the same time he should be careful not to buy a lot of untried machines that would soon be a monument of junk. All the information obtained should at all times be kept in such shape as to admit of ready reference. The engineer on a construction job who cannot

give the needed information quickly will always suffer in reputation, and it may mean a money loss to the contractor as the work may be held up for lack of data.

The engineer's education and training should make him the one best fitted to do this kind of work, and even where the contractor himself has the ability to do it well, his time is so much more valuable in looking after the general features of his jobs that the smaller details should fall on other shoulders.

A great field for engineers in the employ of contractors is the keeping of cost data to be used in systematizing the work. The engineer can get up the various forms and recording books for this purpose and above all can see that these records are analyzed.

The engineer must be careful how he acts towards other employees. This is especially so of the superintendent of the job. Only recently the author was told by the general manager of a large construction company that one of his superintendents and the engineer in charge of the same job could not get along well together, and for that reason the work was costing more money than a similar job where there was perfect harmony between the engineer and the superintendent. Co-operation is the keynote of success in contracting.

The world is making rapid strides, and engineers accustomed to lead are changing with the times. Contractors are rapidly learning this; consequently they are offering salaries to engineers that are inducing them to give up their employment with other corporations to become associated with them. Many of the ablest engineers of the country can now be found employed by contractors, not only as engineers, but also as superintendents and general managers. They are not only obtaining a larger compensation, but also effecting many savings for the contractor.

Some engineers, when they became associated with contractors, seem to think that it is necessary to change their personality; and instead of being the dignified director of work, as when they occupied an engineering position, they take on a gruff air when talking to foremen and laborers and appear as though they thought it necessary to assume the tough air attributed to contractors in popular fiction or upon the stage. It is needless to say that an engineer loses his influence with those under him by such behavior, and makes himself ridiculous.

The duties of a contractor's engineer are not only those covering the civil engineering field, but also mechanical engineering. Although this work has been almost exclusively done by civil engineers, yet many mechanical and mining engineers are now taking employment with contractors, and they are frequently of greater value to a contractor, owing to their training in the design and operation of machinery. Many of these engineers have invented improved machinery for various kinds of construction work, and in many cases the services of these engineers have been such that they have been made members of the firm, in order to hold them.

### *Carrying on Work.*

In order to carry on any piece of construction work the plans should be definite and complete, and the contractor should understand them thoroughly. Then efficient work and economical results can be obtained. Complete plans and definite information mean a low price on the work. A contractor can estimate accurately if he knows what he is figuring; but if he feels that information is being kept from him, he must bid to cover uncertain factors. Essential as such information is to estimating, it is more so in carrying on the work. Neither speed nor economy can be obtained if the contractor is left in doubt as to what he is to do.

In order to carry on his work successfully, he should have such information as will allow him to plan or lay out his work from start to finish, so that he can earn the necessary estimates to carry out the work with the capital he has on hand, and so the work can be finished on time and in a manner to conform to the plans and specifications.

### *Laying Out Work.*

Many contractors give but little thought to a general layout of their work or to the method of attacking a construction job. The first work to be done is planned for, and then other parts of the work are taken up in a haphazard manner, without any decided layout or general policy being formulated. Machines or tools are not ordered ahead, but their purchase is deferred until

needed, with the result that if any delays occur in shipment the contractor suffers the loss.

A thorough consideration of the details of the work to be done and conditions to be met, and a careful preliminary study of the plant installation and managing organization, will result in greater stability in the conduct of the work in general, more consistent and better average speed in its execution, and increased profit at the end. The experience of contractors on large works is proving this more conclusively each year.

One mistake frequently made is not to employ the general manager or superintendent until the job is well started, in order to save paying his large salary for a few months. The excuse given is that not much work is being done, the principal part being the installation of the plant and opening up the work, so that the services of the high priced man can be saved.

This has been done by a number of contractors on the Barge Canal work in New York state, and their work shows the result. The very time his work is needed is at the start. A good man can start a job in such a manner that after a few months he can go to another job, a cheaper man of less ability being left to carry on the work along the lines laid out in an efficient manner.

Present practice among progressive contractors abandons this procedure in favor of a careful planning of the work as to methods to be used and plant to be employed, consideration being given to all probable conditions that may arise. Paper plans are made of plant layout and plant details, and studies are made in connection with plant operation. Such plans for machinery installation and operation should be submitted to a mechanical expert, so as to obtain the best results.

The progress of the work to be obtained and the sequence of doing all the work should be mapped out and recorded on charts or in books. The forces to be engaged should be decided upon and the many details of management put down. Nothing should be left to a man's memory or to chance. The proper foresight means the saving of many dollars. It is in this layout that advice can be sought. One firm of contractors in the middle west has an advisory board to consider such features of their work, while other contractors employ an efficiency expert or industrial engineer to help plan their work. Advice in this connection is proper, but

one man should carry out the plans, although he will find it to his advantage to consult with experts from time to time.

*Working for Estimates.*

Although it is advisable to plan and map out a contractor's work in advance, the all important feature of making monthly estimates should not be overlooked. It is not to be expected that at the outset a job will earn enough money monthly to carry itself; but, on the other hand, there is no need of running a job so in debt that no profit is obtained until the job is finished and the retained percentage is paid.

The work of planning the layout, the installation of the plant and other details can be done, if proper thought is given to the job, while certain parts of the work are being pushed and earning enough money to help in financing the job. For instance, on railroad jobs, as soon as accommodations are provided in camp for some men, work can commence on the grade. Clearing and grubbing can be done, grade points opened up and side hill rock cuts blasted down, so that the estimate received for the first month's work can be a considerable help in carrying on the job. For this purpose every railroad contractor should have some tents in his outfit, so they can be used while more permanent buildings are being built.

Upon one occasion the author had a job of about $130,000 worth of work to start. Outfit worth about $40,000 had to be used on this job, and nearly half of it had to be purchased. The work was so planned and laid out that the plant on hand earned nearly enough money to pay for the new plant as the payments fell due, and without interfering with the speed of the work, as the job was a bonus and profit one.

Ready cash is always needed in order to take advantage of discounts, and if all available money is spent in starting the job, not only will the discounts be lost, but the job will suffer for a lack of money to run it.

On the other hand, a job should not be handled so as to get the cream of the estimates at the start, cutting the work up in such a manner as to make it expensive to finish it, and leaving no money to complete it in a satisfactory manner. Many of the pioneer contractors of the country handled their work in this manner, much to their detriment.

### *Finishing Work.*

The finishing up of the work should always be kept in mind during the progress of the work. The various parts of hardly any structure can seldom be finished as the work progresses, so that this work in most cases must be done at the end of the job. Thus, when the quantities of work have nearly all been estimated, payment must be made for much expensive work, mostly that of labor. In handling the finances of a job this should be considered; but the cost of finishing can be kept to a minimum by seeing that the work is done in the best manner possible, and wherever possible is protected from the weather or from injury by the workmen on other parts of the work.

It is also well to know when the job is bid upon as to how the various structures or parts of the structure are to be finished so as to include the cost in the price; so that although this cost is paid for on the quantities of work done, and during the progress of the job might be considered profit, yet it is in the contractor's hands when the actual finishing work must be done.

# CHAPTER V.

## THE CLERICAL END OF CONTRACTING.

THE clerical part of contracting is generally the most irksome to contractors, no matter what their previous experience may have been in this matter.

### *Office Work.*

The office work is of great importance, and the author has often known all the profit on a job to be made owing to efforts on the part of the office rather than in the field. The old method was to employ a timekeeper who often served as a bookkeeper. In some cases the contractor kept only memoranda of his bills and no real books, knowing only how he stood after paying his payroll and bills, or by referring to his bank balance or cash on hand. If the business increased, a bookkeeper was employed to assist the timekeeper. These methods are archaic, and although a contractor's office force has materially increased, yet in many cases the results obtained are little better than formerly. Many contractors boast of their up-to-date methods in their offices; yet when investigations of these methods are made the system is found to be loose and inefficient.

On the other hand, some of our largest contracting companies have most efficient organizations in their offices. But some have departments that materially interfere with one another, and charts of their organization show that the authority of various officials overlaps. The importance of a competent office force is illustrated by one of the most successful contracting companies in the country. Doing business throughout the world, this company has a good field organization, but owes its success mainly to its excellent office organization and to highly competent men employed in its offices. The head of the company, although well versed in actual construction, is a skillful organizer and has always paid great attention to the development of his office force; and by this means he has put himself among the leading contractors of the world. Many

contractors are retarded in their business by inefficient office organization. Excellent work in the field can readily be offset by a poor office force.

No matter whether a business is large or small its office organization should be practically the same at all times, being simply curtailed or expanded to suit the magnitude of the work to be done.

### *Organization.*

The organization of the office can be divided into six general departments, which can be subdivided further, or two or more of them can be thrown into one when necessary. These departments are:

(1) Executive; (2) financial; (3) correspondence and general office work; (4) purchasing department; (5) selling department; (6) engineering department.

### *Executive Department.*

In most cases the head of the executive department is the president of the corporation. Under him as aids come the vice-presidents and the general manager. In small companies several of these positions can be filled by one man.

In some businesses, no matter of what character, there is at times one man who because of his strong individuality, marked ability and domineering character, dominates every one else; whatever the position or title given him, he will run things, and not even a well thought out organization will act as a check on him. Such men make a success of their work, but unless they have a limited capital, they will find that they do not need partners, and that a stock company is of little use. The business will be run their way irrespective of partners or stockholders. The author's experience is that a contracting business run by such a man dies with him. It is needless to say that a business so operated, although it may be a success, is not well balanced.

### *The President.*

The author believes that in a contracting corporation the president should not be the chief executive, especially as to field work. The general office force should rather be under the general

manager, and all the construction work should be under him. The president should not be a man of large authority. It is not necessary for him even to be well versed in construction work. He should be the presiding officer of the stockholders and directors. He should be a well balanced, discerning man of good appearance, and of an impressive character. A lawyer makes an excellent president of a construction company, although a lawyer who is president should not have charge of the legal affairs of the company.

The president should deal only with the general policies of the corporation. He should be the only official to make any of the company's business public, and he should be the man through whom negotiations are carried on with the public, officials and capitalists. He should have, of course, the advice and assistance of the other officials of the company.

The reasons for this are evident, after a close study and analysis of contracting. The chief executive officer must deal with owners and their engineers, with creditors and with those who owe large sums of money to the corporation. He must also come into close contact with employees, and through them the labor unions. If he is a successful man he must be aggressive, and is bound to incur the enmity of some or all of these. If the executive officer is the president, the effect on the company will be direct. In many cases, the organizations will lose large sums of money and much prestige, and will ofttimes be prevented from obtaining contracts.

If the general manager is the chief executive officer, then the president can stand between him and the enemies he makes, and can prevent any injury to the reputation of the company, especially if he is a well balanced, diplomatic man. Most lawyers possess this ability to a marked degree. Their training makes them close analyzers of any position or occurrence, and they are not bound by precedents, as they are taught to study precedents and then make a defense from the facts. For this reason a lawyer can readily bring about compromises and reconciliations in the business world. More than one construction company has been wrecked by this defect in its organization. There have been men who were not attorneys at the head of contracting companies, who have had this ability, and in some cases they have been engineers and men who had been contractors most of their lives. In one case the author knew a doctor who made an excellent president of

a construction company. Lawyers, however, are as a rule better fitted for this position.

When troubles occur and legal work is necessary, a regular attorney other than the president should handle the case. But a lawyer as president can and will prevent many lawsuits. When various officials do wrong acts, or contracts are broken or are apt to be broken by other parties than the company, the president can handle the correspondence, and in the consultations and conferences with others that are necessary, his legal education and ability will put his corporation in such a strong position that the other parties will generally be brought to terms. With other attorneys handling this work, results are apt to be different, as they are seldom brought into the case until the breach has occurred or the company's rights are forfeited, either through ignorance or in anger. Although an attorney may honestly want to prevent a lawsuit, yet his money is not at stake, and his business is to fight suits at law rather than to prevent them.

### *General Manager.*

For these reasons the general manager should be the chief executive officer of the company. He may or may not be an engineer, but he should be well experienced in construction work and should have ability to handle men. The position of president and general manager should never be occupied by the same man.

Divided authority in handling the field end of contracting should never be allowed. An advisory board to determine methods of conducting the business or to consider some difficult engineering features, can be recommended; but for carrying out the plans and conducting the general business one man should be supreme. As one prominent contractor puts it, "One man must be Boss, with a large capital B." When two or more have authority there will be clashes, and the forces will become disorganized. One man depending upon another, will find that important matters are neglected, and procrastination will become a fault with all; for each man will defer to another's opinion, or will wait for some one else to act. A man acting by himself will sometimes make mistakes, but things will be done; and when results are obtained it is much better than not having things done, even though mistakes are made at times.

The general manager should be in charge of all the business, both in the office and in the field; but he should be relieved as much as possible of the office work, so that the greater part of his time can be devoted to the carrying out of the various contracts. He and the chairman of the finance committee should work in harmony, the general manager being a member of that committee. The general manager, however, should report only to the board of directors, and only that body should be able to discharge him.

*Superintendents.*

For each contract there should be a superintendent reporting to the general manager. Under the superintendents there should be assistants or walking bosses for each camp or section of the work.

To assist these men and the general manager, the latter should employ construction economists or efficiency engineers. An outside man can always do more to systematize and organize work than one actually employed for his entire time.

*Vice-Presidents.*

There can be one or more vice-presidents. They serve in the place of the president when necessary, and can occupy other positions and have charge of certain departments.

*Financial Department.*

This is often the weakest part of a contracting organization, yet it should be one of the strongest. The head of it should be the chairman of the finance committee. No matter what other experience he may have had, he should be a man of marked financial ability. He should pass upon the financial responsibility of all parties with whom contracts are made, and should outline the financial policy of the company, acting in all of these matters with the general manager.

Under the chairman of the finance committee should be the treasurer, who should be the custodian of the money of the company. All checks should be signed by him and another officer, preferably the general manager.

Under the treasurer should come the auditors, bookkeeper and other financial clerks.

Financial statements should be furnished the general manager and chairman of the finance committee at frequent intervals.

### *Bookkeeping.*

The bookkeeping should all be done on a uniform system. On each job or contract a set of books should be kept, and from vouchers, forms and reports these should be reproduced at the main office and become a part of the general books, thus showing quickly not only how any particular contract stands, but also the general condition of the business.

The books should be explicit, showing the receipts and expenditures in great detail, but they should be entirely separate from the cost keeping. The cost keeping should be auxiliary to the bookkeeping.

There are many systems of bookkeeping, and each man is more or less wedded to the one to which he is accustomed. Some use various books and others use forms of different kinds that are filed in cabinets. The author can recommend either books or forms, and the following general system.

A day book as ordinarily used is not needed; but numerous books are used that might be termed day books, as daily records of expenses are kept in them. These are the time books, the petty cash book, account of magazine expenses, the tool and oil books, the sales of merchandise, the kitchen record, and the material books. These might be termed day books, since they are daily records, and should be closed up each week or month, and posted into the book of original entry.

The general accounts opened should be as follows:

(1) Capital Account.
(2) Surplus or Working Capital.
(3) Dividends.
(4) Office Expense.
(5) Expense of Work.
(6) General Expense.
(7) Plant Acount.
(8) Sinking Fund Account (Plant).
(9) Depreciation of Plant.
(10) Repairs and Renewals.
(11) Bank Accounts.
(12) Petty Cash.
(13) Bills Payable.

(14) Bills Receivable.
(15) Interest and Discount.
(16) Estimates Earned.
(17) Estimates Received.
(18) Retained Percentages.
(19) Profit and Loss.
(20) Labor Account.
(21) Materials of Construction.
(22) Merchandise Account.
(23) Camp Account.
(24) Kitchen Account.
(25) Magazine Account.
(26) Stable Account.
(27) Insurance Account.
(28) Personal.

Other entries will suggest themselves, and at times some of those given will not be needed. The merchandise account is used for any goods bought and sold again, as to laborers, sub-contractors or the general public. The book of original entry becomes the day book and the items are at the same time journalized for entry into the ledger. This book is arranged as follows:

Two entries are made in the form to show how it is done. Groceries are purchased from Jno. Smith & Co., to the amount of $200. These are charged to merchandise and credited to the personal account of John Smith & Co. When the bill is paid the account of John Smith & Co. is charged with $200.00 and bank account is credited with this amount. Then a sale of $50.00 of groceries is made to D. Jones. This amount is credited to merchandise and charged to the personal account of D. Jones. When he pays for them his account is credited with $50.00 and the bank account is charged with this amount.

The personal accounts are entered into the ledger each day, but the others need only be entered once a week or once a month. Before entering, the columns are footed up and those on the two pages should balance each other. In making the entries of all except the Personal and Bank accounts, only the totals are entered and not the various items. Department and monthly charges are made in the same way.

Such accounts as Capital, Surplus or Working Capital, and Dividends should be kept in a separate book, the treasurer keeping such a book himself (the labor to keep it up being small), and thus employees will not know the details of such things.

This method of keeping books is very simple and is a great labor saver. Millions of dollars worth of business can be recorded

| Gen'l Expense | Expense Work | Bank | Mdse. | Personal | Folio | Dr. Notation | Cr. Notation | Folio | Personal | Mdse. | Bank | Expense Work | Gen'l Expense |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 200.00 | | 40 | Groceries | Jno. Smith & Co | 21 | 200.00 | | | | |
| | | | | 200.00 | | J S & Co. | Cash | | | | 200 00 | | |
| | | | | 50.00 | 15 | D. Jones (Sale) | Groceries | 40 | | 50.00 | | | |
| | | 50 00 | | | | Cash | D. Jones | | 50.00 | | | | |
| | | | Page on Left | | | | Center of Book | | Page on Right | | | | |

Fig. 1.—Sample of Book of Original Entry.

at a very small cost, and every detail and every cent is accounted for and can be shown at short notice. As previously stated, the books kept at a branch office can be reproduced with small labor in the main office. Vouchers should be used to pay all bills. These vouchers should be made out at the office where the debt is incurred and then forwarded to the main office. These vouchers can be made with stubs so that a record is easily kept of them in the branch office, while in the main office they should all be entered in a voucher book. Vouchers can be of two kinds, voucher checks, or vouchers to accompany checks. There should also be record vouchers. These can show small transactions, records of money and materials taken from one job to another, and various department changes, such as division of the payroll, merchandise used for camp, office or kitchen, and similar things.

The bookkeeping is thus made very simple, yet quick, effective and specific, and gives results and costs for easy reference.

### *General Office Work and Correspondence.*

This should be in charge of the secretary of the company. He should work in accord with the general manager, and should relieve that official of all office work possible. The secretary should also report to the president. The general correspondence should be carried on by him, and he should have charge of the general office force of clerks, stenographers and filing clerks.

The secretary should keep the stock books and have charge of the seal of the company. He is also the officer under whom the legal department should come; but the general counsel should also report to the president of the company. The secretary or some of his assistants should serve as secretary of any committees of the stockholders or directors.

### *Purchasing Department.*

In a large corporation this is one of the hardest departments to handle. In a small company or partnership the man in active charge of the work generally does the buying; and there is little difficulty experienced as he buys only what is needed and the tools, supplies and machines purchased are those best suited for the work.

With a large company things are different. Jobs are scattered in different parts of the country, and it is not always possible for one man to purchase all the necessary things. This might be done for heavy machines and materials or for supplies that can be anticipated some weeks in advance; but many things must be bought locally and on short notice.

The qualifications of a purchasing agent for a contractor are many, and are difficult to define. A man who is experienced in handling men and machines would be best fitted for the place, but such a man is needed in the field and as a rule in found there. An experienced engineer might make a competent purchasing agent, but he, too, will make more money for the company in charge of the engineering features. Accordingly, a young man or office man occupies this position.

Much money can be wasted in buying useless supplies and in duplicating orders. Men working on a job always want to see a large amount of material and supplies on hand, and inasmuch as the cost does not affect them, they are very extravagant in ordering and in making requisitions. It is economy to keep on hand all needed supplies, small tools and parts for repairing machines, as time lost by men and machines through a lack of such things can quickly amount to many times the interest on the money so invested; but, on the other hand, if too much money is invested in such supplies, the interest loss is great. This, however, does not amount to as much as the loss of the same amount of actual cash. Ready money is always in demand in any business and especially in contracting. Bills of all kinds can be discounted for cash, and the money thus earned in a season or a year will be many times the interest charge on capital invested. The author has known ten dollars to earn in discounts in a single season seven dollars and a half.

If a workman needs a small tool or some supplies, and they have been mislaid or he cannot readily find them, he orders new ones. If tools have been used at one place and not returned to the store house, new ones are generally ordered, especially if they can be gotten quickly. Many things are also ordered that are not really needed. Men make requisition for many things that must be ordered by sizes, and although there may be no need of such sizes, it is difficult to have these things returned to the merchant, so that in many cases they become an entire loss.

A purchasing agent must learn these things and be able to discriminate; and he should have on record in his office the sizes and stock numbers of all machines, with names of makers. This will prevent expensive mistakes. Names used in the field for some articles are different from those used by manufacturers and merchants, so that care must be exercised in this particular to prevent mistakes in ordering with consequent delay and waste of money.

Owing to a lack of knowledge of practical work and the adaptability of machines, purchasing agents make many mistakes in buying equipment. A special type or make of machine is ordered by a superintendent, and the purchasing agent buys a similar machine for less money than the one specified can be purchased for. He believes he has saved money; yet it may be an expensive purchase, costing much more than the other machine for maintenance or operation, or both. Then a salesman visits a purchasing agent and calls his attention to a vastly superior machine; but through lack of knowledge the purchasing agent refuses to listen to the man, believing the machines of this character already owned by the company to be as good. It may be wrong to try out every new machine; but it is just as wrong, and may be the means of losing much money, not to learn of improved machines that cut operating costs, or increase the speed of doing work.

As far as possible the purchasing should be centralized. As previously explained, it is not possible to do this absolutely; but all office supplies can be bought by the head of the purchasing department, so that printing and forms will be uniform; and the majority of other things can also be bought from one office. For this purpose order blanks can be employed and the same blanks can be used both for making requisition on the main office and for ordering. A rule should be established that nothing can be bought except on an order blank of the company, and even when this order is sent direct to the merchant from a branch office, a duplicate should be sent to the purchasing agent.

All material clerks and storekeepers should be under the purchasing agent, and should make frequent reports to him not only of materials and supplies on hand, but also of those used. Duplicate reports of those supplies used should go to the cost keeping department.

There is much to be learned about buying, and until a man makes a close study of the basis of manufacturing and selling

goods, the various freight allowances, trade discounts, factory deliveries and many other such details, he will never be an economical buyer. He must also know the ability of manufacturers to make prompt delivery, and must also know of the responsibility of different concerns, so that contracts made with them will be carried out.

The selling of any goods or materials to employees or to sub-contractors should be done under the purchasing agent, and he should also have charge of selling machinery and tools that are not needed. Often in purchasing new machines he can trade off old ones, but such machines can generally be sold to advantage to sub-contractors.

*The Selling End of Contracting.*

This department should be devoted to selling the services of the contractor or construction company. But few companies have such a department, depending upon chance or haphazard methods for obtaining new work; but there should be a well organized force to keep record of proposed new work, to solicit jobs and keep the company in friendly relation with all those from whom work is or may be obtained. This subject is discussed fully under the head of "Obtaining Work," in Chapter IV.

*The Engineering Department.*

Elsewhere in this treatise the relations between engineers and contractors are discussed, as well as the need for a contractor's engineer. Here the comments are restricted mainly to the organization of the department. The head of the department should be known as the chief engineer, or, as the engineer in charge. He should be immediately under the general manager.

There should be a consulting civil engineer, and a consulting mechanical engineer, and, at times, an electrical engineer, to whom the chief engineer can go for advice. Under the chief engineer there should be an engineer for each job. The latter should work under the various superintendents and in harmony with them.

The engineering department should do all the estimating on new work, and should prepare the plans for temporary structures, forms, centering, and similar structures. The plant layout should also be planned by this department.

When plans, drawings and profiles are received from the owner's engineers, they should be placed in the custody of the engineering department and the date of receipt put upon them. This should also be done for bills of material. When changes are made the old plans should be kept for reference in case any trouble arises from changes made, and for filing claims for extras due to such change of plans.

### *Progress Reports.*

A record of progress made on the work should be kept and shown on progress profiles, charts or diagrams. This is of importance, as not only officials of the company will use this information, but it will prove valuable in case of disputes, especially when a quick finish is demanded on the work. The engineering department should also have photographs taken of all the jobs. These should be taken at certain intervals to show the progress of the work, and all difficult features should be photographed, as well as unusual conditions that affect the cost of the work. In excavation, photographs showing rock and other materials should be taken.

The craze for cost keeping has to some extent drawn attention from the importance of progress reports. Without such reports being made and properly recorded, great speed on most contract work is hardly possible. Speed is of great importance in contracting. Not only does it mean decreased cost of construction, but it enhances a contractor's reputation, so that it is easier for him to obtain new jobs. Speed means finishing jobs on time, or even ahead of time, a thing few contractors seem able to do.

### *Cost Keeping.*

The keeping of costs, and their analysis, should be done under or by the engineering department. Daily reports are made on slips and forms; but to preserve the information they should be entered into a book made for the purpose. A book properly devised for this will allow of quick comparisons and easy and careful analysis. Hundreds of slips are seldom referred to, and many of them soon become lost. Large sheets are also mislaid and are cumbersome to handle. A book, on the other hand, is convenient and admits of quick reference.

The value of cost records, especially those kept and used by

one company, can hardly be estimated. A record should be kept for every item of work done, and for the purpose of carrying on the work this record cannot be kept in too much detail. Some writers who incline towards gathering a vast scrap book on costs state that fractional costs are not necessary, and are not adapted to their purpose; but for conducting work on an economic basis such details of cost should be kept.

### *The Value of Cost Data.*

It has been said that cost data are of value as long as methods of work remain the same and the price of labor is known. To a great extent this is true, yet many take exception to such a statement, and with reason. Many cost data are of little value except to the man who keeps them, owing to the fact that they are incomplete. Many costs that are recorded and published are in scrap book form, there being little or no connection between them.

On the other hand, costs should be and are the basis of all commercial engineering and contract work. One of the greatest of American engineers once defined engineering "as the art of doing work for one dollar that any bungler could do after a fashion for two." This is a true definition, and the American engineer and contractor excel in this art. This alone shows the necessity of the engineer and contractor knowing costs.

During recent years there has been much hysteria regarding cost data. Some have advocated costs and cost keeping to the exclusion of everything else. Cost data have been cried from the house tops as the panacea for all evils. On the other hand, others have attempted in their ignorance to cry down this important feature of modern engineering.

Many engineers and contractors are capable and competent to originate and develop a scheme or method of cost keeping. Others can adapt methods already devised to their own needs, and any one can keep costs under verbal or written instructions; but the application of costs to other jobs and for the purpose of systematizing work is another matter.

"How do you mix your paints, Mr. Opic?" asked a student. "With brains," was the reply of the great artist. Discretion, experience and ability are needed just as much in using costs as in using paints. The novice can do more harm than good in

handling cost data, yet this should not deter anyone from keeping costs or from making a study of them. A man who has done comparatively little work can become proficient by careful analyzation and study of costs, just as he can become a competent designer by study and practice. The essential thing is to master a subject so that one can apply one's knowledge.

### *Cost Analysis.*

Cost keeping and cost analysis are often confused. The author has heard many engineers and contractors speak of a cost analysis they had kept, when they only had a cost record that had never been analyzed. Keeping costs is simply amassing records, which when completed are known as cost data. Cost analysis is the reduction of these data to unit costs, and the analysis of them so as to obtain man, machine or animal units. It consists in segregating and listing costs so that they can be readily applied in estimating the cost of new work, in reducing the cost of work that is being done, and in developing methods and systems of carrying on different kinds of work.

This is the all-important feature of costs, and unless costs are analyzed, their true value is never known. It is for this handling of costs that one must make preparation; one must be familiar with methods of doing work, have knowledge of the various kinds of machines and their outputs, and must know the number of units of work that a man can do in a day. One may study costs without this knowledge, but one can not apply them to the best advantage without it.

One reason that many cost data are of little value except to the man who kept them, is that such data are incomplete. Many details are not recorded for future use. Among the things frequently omitted are wages, the number of hours worked per day, the many local conditions, the time of the year the work is done, the condition of the labor market, the ability and efficiency of the management, the plans and specifications governing the work, and many other details.

### *Specifications Affect Cost.*

The necessity of knowing the specifications has never to the writer's knowledge been alluded to in a discussion of this sub-

ject, yet on some classes of work they must be known in order to give the cost data any great value. This information is necessary whenever several classes of work, for which unit prices are paid, are done together, and it is not possible to keep the costs on each class. Then the specifications must be known so as to understand how the various classes of work are to be divided; and in order to reduce the costs to unit costs, the contract price for each class of work must be known. This is especially true of classified excavation, such as is done in railroad construction.

On such work there is generally a classification of earth or common excavation, loose rock and solid rock, and on some occasions hardpan. On different railroads the specifications for excavation vary exceedingly. Some materials that are classed under the head of loose rock, as shale, fire clay, shale and chert, are on other roads considered earth, although they cannot be moved except by blasting. Likewise, there is a vast difference in the classification of loose and solid rock. Many roads make all stones or boulders less than a cubic foot come under the earth class, others use one-half a cubic foot. The majority class everything less than a cubic yard as loose rock, and solid ledges and larger boulders as solid rock. One road in the south goes to an extreme in this, inasmuch as it throws into loose rock all ledges of solid rock of six inches or less in thickness, separated by strata of clay. If only a single stratum of partly decomposed rock is found in a cut, such a specification would not be so bad, but it is readily seen that alternate thin strata of rock and clay can make a job of excavation a very expensive one.

*Factors of Costs.*

Naturally, the cost of rock excavation will vary considerably, owing to the conditions surrounding the work and the methods used. The character of the rock, as well as the angle of the rock to the plane of excavation, will materially affect the cost. The nature of the excavation to be made will enter into the cost, as, in railroad construction, a side hill cut can be made much cheaper than a through cut. Then an important item is whether or not the material to be moved is entirely rock or a mixture of rock, boulders and earth.

In keeping cost data for rock excavation it is a simple matter to arrive at the unit cost of removing solid rock and earth if all

the material to be moved in a cut is either one or the other, or if first one class of material is excavated, and then the other, when two are found together. But, it frequently happens that a single cut will have solid ledges, disintegrated rock, large and small boulders and earthy materials, and the material will be in such shape, or the excavation will be so situated, that the various materials must all be excavated together; and it is then impossible to keep the cost of each class of material separate.

*Comparative Costs.*

With the entire cost of the work kept, and the yardage known, an average price for excavating a cubic yard is easily derived; but this is useful only when the excavation is not classified. For classified work it is not possible to obtain an accurate unit cost for each class of material, but a cost comparable to the contract price paid can be obtained. With such work, the specifications must be known to give the greatest value to the data, and the unit costs cannot be calculated without knowing the prices paid for the work.

The method of determining the cost is readily illustrated by an example. A contract has been made for some classified excavation at 60 cents per cubic yard for solid rock, 35 cents for loose rock and 20 cents for earth. The actual cost of moving a small cut of 1,000 cubic yards was $350. Under the specifications the engineer classified the cut as follows: Six hundred cubic yards of solid rock, 300 cubic yards of loose rock and 100 cubic yards of earth. This classification at the contract prices would give the contractor $485, netting a profit of $135.

Now it is found that the cost of doing the work is 72 per cent of the amount earned, so that the cost of each unit is 72 per cent of the price of each unit, making a cost for solid rock of 43.2 cents per cubic yard, loose rock 25.2 cents, and earth 14.4 cents per cubic yard. If a money loss had been sustained on the 1,000 cubic yards, saying the cost had been $543, then the percentage would have been 112, and the rock excavation would have cost 67.2 cents, the loose rock 39.2 cents and the earth 22.4 cents.

It can be seen that these are not true costs, but as previously stated, comparative or proportional costs. In a case where money was lost, the earth may have been moved at a profit, and likewise the loose rock, while all the loss was sustained in blasting and

handling the solid rock. Yet a proportional loss would show on both the earth and loose rock. If greater details of costs have been kept, such as explosives, separate from labor and teams, and subdivide further these costs, the proportions of each detail to the whole is calculated. For example, if the $543 is divided, $70 for explosives, $353 for labor, and $120 for teams, then the detail cost of the solid rock would be 8.74 cents for explosives, 43.68 cents for labor and 8.74 cents for teams, or a total of 67.2 cents.

To illustrate how the specifications will affect the cost of such work, another example will be taken. Some years ago the author excavated a cut on one of the southern railroads, the yardage in it being 7.867. Under the specifications governing the work, chert was classed as earth and slate as loose rock. The engineer in charge classified the work as follows: 2,619 cubic yards of earth, 2,831 cubic yards of loose rock and 2,435 cubic yards of solid rock. Even following the specifications this was a low classification. Of the earth about 600 cubic yards was chert, and about 1,100 cubic yards of the loose rock was a hard slate. The total cost of excavating the cut was as follows:

| | |
|---|---|
| Explosives | $ 265.55 |
| Foreman and laborers | 1,619.35 |
| Teams | 273.25 |
| Total | $2,158.15 |

The average haul of the material was 350 feet. One and one-half yard rotary dump cars were used, one mule and a driver operating two cars. The costs of explosives used were: Black powder, $1.22 per keg; 40 per cent nitro-glycerin, 11¾ cents per pound. The average wage paid to men was 13.4 cents per hour, and to foremen 28.6 cents. Two cars, one mule and a driver were charged at $2.00 per day. The cost per cubic yard for the work was: Solid rock 46.8 cents, loose rock 24.6 cents and earth 12.3 cents.

Now had this work been done for a competing railroad which had attempted to locate a line through the same mountain pass, a different classification would have been put on the work, since under this road's specifications, chert is classified as loose rock, and slate as solid rock. Thus the 7,867 cubic yards would have been classified as follows: 2,019 cubic yards of earth, 2,331 cubic yards of loose rock and 3,535 cubic yards of solid rock. The total cost of doing the work remaining the same, and the contract prices un-

changed, the unit cost for doing the work would then have become as follows: 40.9 cents per cubic yard for solid rock, 21.4 cents for loose rock and 10.7 cents per cubic yard for earth. For easy comparison they are placed thus:

| | Solid Rock per cu. yd. | Loose Rock per cu. yd. | Earth per cu. yd. |
|---|---|---|---|
| First specification | 46.8c | 24.6c | 12.3c |
| Second specification | 40.9c | 21.4c | 10.7c |

From the cases cited it is seen that in considering such costs the specifications must be known, and not only kept in mind, but notes must be made as to the manner in which they were interpreted.

What is true regarding this class of excavation is also applicable to concrete work, when several grades or proportions of concrete are used in a structure, and in such a manner that it is difficult to keep the cost of each separate, the various grades being paid for at a common price. Any costs must be proportional ones, based on the amount of cement used.

The same principle also applies to other classes of work, and shows the necessity of carefully studying and analyzing costs before applying them to other work.

### *Costs and Prices.*

Costs and prices should never be confused. Costs are the actual costs of doing work, of labor and material; while prices are supposed to include a profit, although the profit may be so small, or the conditions under which the work had to be done may have been so adverse, as to show a loss in some prices. There cannot be such a thing as a "going price" for contract work; the variation in specifications alone will prevent this; and so many factors enter into contract work that it sometimes becomes a difficult matter to estimate costs, so that prices cannot be constant. Costs can be converted from one basis to another under certain conditions; but prices cannot be so converted, for records have not been kept to show variation in prices due to the reasons given above.

A collection of prices can have but little value, except to a man wishing to sublet work from a general contractor, when the price obtained might not equal that given to other sub-contractors or the sub-contractor wishes to know the prices of the general contractors from whom he means to obtain work.

*Making Public Cost Records.*

Some contractors absolutely refuse to make public cost records. They believe it is giving away trade secrets to do so. This is as erroneous an idea as that of not needing to keep costs. The man who does not keep cost records, will have none to make public; but when cost data are obtained on a job, no one will be the worse off for publishing them.

Trade secrets are a thing of the past. We find such customs still in vogue in China and other parts of the Orient, but they are hardly needed among English speaking people.

A man may make public all of his cost records, giving wages paid, local conditions, diagrams and photographs of the work—each minute detail and its cost—yet he cannot give to the public his individuality that made these costs exceptionally low. A competitor may endeavor to follow in his footsteps and fail utterly. Neither can one make public the organization he has created, through which he obtains satisfactory results. Not only these, but many more features cannot be conveyed to the public. These still remain with the individual. For these reasons the contractor, making public his cost records, is not injured, but he can be benefited.

Through public cost data the engineer learns much about the practical side of engineering construction. He is able to know when he receives a reasonable bid or price upon his work, and the time it takes to do different sized jobs and classes of work. The engineer is further enabled to see how his specifications may have increased the cost of the work without any direct benefit.

Competitors learn one's prices, but only to confuse them. A contractor depending entirely upon cost records of another firm will soon come to grief. In this world, we have all got to give up something for the benefit of mankind. It is our duty to add somewhat to the knowledge of the world. The contractor does this by making public his cost records.

# CHAPTER VI.

## CONTRACTOR'S WORKMEN.

### *Work in Cities.*

A CONTRACTOR working men in a large town or city finds an entirely different proposition from handling a large crew of men in the country. In the city the contractor simply works his men. He knows little about them, often not even where they live, and does not concern himself about such things as long as the men do efficient work. The men report for work in the morning, coming from various parts of the city; work during the day and disappear at the end of the day's work. If the night is spent in drinking and carousing, the man either does poor work the next day or does not report for duty at all.

The contractor does not concern himself about these things, for the man is discharged if his work is poor, and each morning, unless work is very plentiful, a gang of unemployed congregate on the job, waiting several hours on the chance of being put to work. Discharged men or those not reporting for duty are quickly replaced from these applicants, while if a mechanic is needed and none applies for employment, one can be obtained without much trouble by telephoning to the headquarters of the union of that class of workmen.

Limiting the number of hours of employment likewise affects the city contractor but little. If men are to be worked only eight hours, it is of no great importance to the contractor, as long as he knows this fact before he makes his proposal for the job. He knows too, that in many lines of labor he obtains more work per hour from his men on an eight-hour basis than in a ten-hour day. In some cases this fact alone will enable him to pay a higher hourly wage, if all other things are equal.

Pay-days afford the city contractor little uneasiness or trouble. His accounts are generally simple, as he only has his men's time to run out and a payroll can be made up with little labor and with dispatch. Many of his men do not get drunk, as their families

prevent this, and even those who may drink excessively do not come onto the work to interfere with the labor of those who are in condition to work the next day. Besides, pay-day in towns and cities generally comes on Saturday, thus giving the men Sunday in which to get over the effects of a debauch.

### *Work in the Country.*

When a contractor leaves the city and takes up work in the country he has many new problems to solve. The farther he goes from a base of supplies to do construction work in an unbroken wilderness or through unsettled mountainous country, the greater the problems which arise to vex him.

### *Obtaining Workmen.*

All of these things mean that many classes of laborers must be employed in addition to the regular common labor. Clerks, bookkeepers, timekeepers, storekeepers, blacksmiths, mechanics of various kinds, machine operators and many others must be obtained. The word "obtained" is used advisedly, for before they can be employed they must first be obtained.

Advertising for men has been done to some extent, but has not proved very successful. The contractor or his superintendent seem to prefer to see the applicant face to face before employing him. This applies to a great extent to all except common laborers. Many a contractor has been compelled to send men, in whom he has confidence, to hunt up the workmen he needed.

These men were often competent superintendents and foremen, but many of them lacked the gift of picturing camp life and the work attractively, so, unless the army of unemployed was large, sufficient workmen were not readily obtained. The contractor then learned that he must employ trustworthy men with special ability along the line of obtaining workmen, to keep continually on the lookout for competent men to replace poor ones, and to keep the ranks full when men left or were discharged.

### *Labor Agents.*

These labor gatherers found that they could make more money by setting up independently and furnishing laborers to a number

of contractors. This started the business of "labor agent." Laws were passed in various states to license these men and to protect them from the unlicensed agent, who goes to some particular city or town to take away a gang of men. These laws are entirely proper, as the man who pays a license and makes a regular business of furnishing help should be protected from the interloper, but at the same time they added to the expense account and to the troubles of the contractor. His own agents could no longer go to a town or city and collect a large gang of men to carry from that point to the job, unless he paid a license for his agent. As the contractor found it necessary to send for men in three or four different states, obviously he could not afford to pay the license in all of these states, so his agent obtained the men from the regular agents. This meant that either the contractor must pay a fee to obtain the workman, or else the latter must pay a fee to the labor agent for the job.

### *Transporting Men.*

The contractor has to pay out much other money before he gets the men into his camp and at work. First, they must be fed, as in nearly every case the workmen themselves are short of funds, and even if any have money, they keep it hidden. Then railroad fare must be paid, and this alone becomes a large item for a gang of fifty to one hundred men. When the end of the railroad journey is reached, there is the expense of transportation of the men by teams, and at camp the men must be properly fitted out. First, they must be fed until they earn money to buy their own food. Then blankets and bedding for their bunks must be furnished, and in many cases clothing and shoes must be supplied. Men, like horses, must be well shod to do efficient work.

This is all money furnished by the contractor, and what protection has he in the matter?

With union labor, especially trades that have a strong union, these expenses are a direct charge against the work, as the rules of the union not only call for the employer to pay for the car fare of men transported to different parts of the country, but the employer must also furnish good meals and pay for Pullman accommodations for sleeping on trains, and for berths and such things on boats. Besides this the men must be paid regular wages for day traveling, and when they travel both day and night

they must be paid time and a half. Wages must also be paid for time lost in waiting to go to the work. In some cases return transportations must be furnished the men. A union man so transported is under no legal obligations to work for the contractor paying him, although some unions prevent contractors sustaining a loss from this cause.

With non-union and common labor, he can charge all money furnished or spent on their account and deduct it from wages after they start to work. However, quite a number of the men never go to work. Even on the trip from the labor market to the camp, some of the men run away, in spite of the best of watching and care. Then, when they get to the work some of them disappear, while others become dissatisfied and leave after working only a few days. Even when many of those who have stayed and worked off their indebtedness get a few dollars ahead, they go to work for some other contractor, nearby. The contractor has no legal redress for his desertion and failure to work out indebtedness. The laborer may solemnly promise in the presence of witnesses that he will repay this money, either by his labor or with cash, but if he does not do so, the contractor cannot hold him legally for it, as the laborer has not obtained anything under false pretense, but has simply broken his word. This is a distinction of the law.

It is evident that contractors need some legislation to protect them in this matter. The labor agent is protected in many states for his fee, which comes either directly or indirectly from the contractor. But until lately contractors have never had an organization that could work for reforms of this character.

Another factor of cost in this matter is that a man heavily in debt to his employer will not put forth his best efforts, save in exceptional cases, and hence there is little profit to be made from a gang of new men. It sometimes takes the few that remain with the contractor some months to make up the loss on those who run away. This is a factor of cost which varies exceedingly, and is seldom taken into account in published cost data.

One method the author has used to prevent losses of this character is to make a rule that all unmarried men who come to the job "on transportation,"—the phrase used to denote men who have had their expenses paid—must board at the cook shanty as long as they owe money for transportation or for other things furnished. In this manner they are always in debt for their board. Nearly

every state in the Union has a law making it a misdemeanor to leave one's boarding place without paying the board bill. A warrant can be sworn for the man leaving, and if caught, he can be held for his board. Rather than go to jail he will be glad of the opportunity to work out his debt. At times a warrant for a week's board can be held in camp in the name of John Doe, and used as occasion arises.

### *The Padrone System.*

These evils, and the changes in the class of common labor in many sections of the country from Irish to Italian, or Negro to Italian or other foreign labor, brought in the padrone system of working laborers. Contractors running several jobs and employing large numbers of men could not give all of these details personal attention, and as they were losing money under the old system, and were handicapped in taking contracts by a lack of men, they readily turned to any system that seemed to offer relief.

The padrone is generally an Italian who speaks fairly good English. As a rule he has a partner. These men agree to furnish all Italian and foreign labor to the contractor free of cost, and in such numbers as wanted, upon reasonable notice when additional men are wanted. The padrone likewise provides shanties for the men and runs a commissary. The contractor pays for none of these things, but he agrees to deduct any amount of money due the padrone from the laborer's wages, and to pay it to the padrone after pay day. For this the padrone sometimes agrees to pay the contractor a percentage of the amount so collected.

In the abstract, this would seem an ideal method. The contractor is furnished with workmen promptly when he needs them, and in sufficient numbers to keep his work going at top speed. His chances of loss in obtaining men are entirely eliminated, and for all foreign labor, the contractor does not need even a camp. Since the padrone speaks Italian, he is able to deal intelligently with the men, and to make a living from his sales to them. In actual practice, however, things do not always work out in such a satisfactory manner.

Generally speaking, the best class of labor agents are able to do a good business without becoming padrones, and so we find even Italian labor agents who will not consider becoming padrones. At the same time there are some excellent business

men who are padrones, and who have had close business relations with the same contractor for a long term of years.

If a padrone is not a labor agent he is compelled to go to agents to get the majority of his men. He pays the agent a fee for obtaining the workmen, which is generally charged against the latter, and sometimes a commission is added. In transporting the men, party or trip tickets are purchased at a reduced rate, but in many cases the single trip fare is charged to the men. Men are charged with a monthly fee for straw or bedding as well as for shack or shanty rent.

If the padrone is also a labor agent, and obtains a fee from the workman for giving him a job, the padrone can make it profitable to get rid of men so that he may continue to bring in new men all of the time. The writer knew of one case where the padrone cleared nearly five dollars on each new man, and as this was much more than he could clear on one man in a month, he found it to his interest to get rid of men as soon as they were out of his debt, and to bring in new ones, on whom he made a handsome profit. This was certainly a detriment to the contractor.

In other cases, the padrone will not allow good foreign laborers to go to work when they come to the contractor of their own accord for employment, unless these men agree to pay to him some *flat fee or some regular sum each month*, whether or not the workmen stay in the padrone's camp or deal at his commissary.

There are continual strikes and disputes caused by the prices charged in the padrone's commissary. At one time the cheese is too high; again the macaroni is poor, and so on with numerous articles, for which the contractor is not responsible but which cost him money. The men must eat, even when they do not work, so the padrone loses nothing by a strike. But the contractor cannot make money when his men will not work, and a strike among his common laborers, tying up his work, means that all his men on monthly salaries are prevented from working, and thus he sustains a heavy money loss.

The character and grade of goods which the padrone keeps in his commissary are also an important matter. In the winter time men must have warm clothes and bedding in order to do good work. Frequently the padrone has but a poor supply of such goods. This is apt to be especially so of footwear. The foodstuffs

also are not always what they should be, and men must have good wholesome food to give them strength to work.

In the West it is customary to let the boarding privilege to a boarding contractor. The men are fed by these contractors. Some years ago the service of these contractors was poor, but the successful ones have learned that it pays to provide wholesome food and plenty of it, thus satisfying his boarders as well as the contractor.

Another objectionable feature in the padrone system is the selling of beer. Nearly every construction contract contains a clause preventing the sale of liquors of any kind. This sale of beer is a direct breach of this provision of the contract. It is likewise against the law, as a state license is seldom taken out. The sale of beer also provides an opportunity to sell whisky. The padrone will also treat the foremen to beer and whisky to gain their favor, but to the detriment of the contractor's business. This sale of beer is justified by stating that it is impossible to work Italians without selling beer to them. This is wrong. Italians do not drink beer to any extent in Italy, and the writer has worked many gangs of Italians and other foreign laborers without selling beer to them, and has found it very satisfactory. It is true that those who wished to supply themselves with beer did so from other sources, as any laboring man will do.

The padrone system is also apt to break up an organization and cause inefficient work to be done. The padrone does not always tell the new men the true conditions under which they are to work, such as wages, hours of work, pay days and other details. Thus, dissatisfaction is caused as soon as the men arrive on the work.

Men who are discharged at one camp are sent to another camp by the padrone, interfering seriously with the authority of the superintendents and foremen. A padrone furnishing several contractors on the same piece of work has been known to take men from one contractor to another, when ordered by one of the contractors to bring in additional laborers. This causes dissatisfaction not only among the contractors but also among the laborers themselves.

Naturally the padrone is more interested in a man spending his money in his commissary than in his efficiency as a workman. The author's experience has taught him that many of the best laborers are small spenders at the commissary. Some padrones

make it so unpleasant for these men, that they leave and their places are filled by men who are more profitable.

It is almost impossible to point out all the abuses that exist in the padrone system; but it is only fair to state that in some cases it is carried on with entire fairness and has worked in an ideal manner.

The whole principle, however, is wrong. The contractor gives over the control of his men to another, and licenses that person to make his living from the workmen. If a man is to control the contractor's men during work hours, when they are living in a camp, he should have control of them during their hours of leisure. If the padrone makes a profit from the men, why should not the contractor, who furnishes the men the work, have this profit? No other business man would turn over the control of his employees to another. The old system has its faults and drawbacks, but it is clearly the lesser of two evils.

The author believes that the best method is to have responsible labor agents furnish contractors with the men they need and for the contractors to run their own commissaries and care for their own men.

### *The Care of Men.*

If men are worked hard they must be paid promptly according to agreement, and some thought and study must be devoted to the care of their mental and physical welfare. In city work this is provided for, but on jobs outside of towns and cities contractors must care well for their men, if they expect to hold them on the job, and obtain efficient work.

Comfortable houses should be provided and a man detailed to keep them clean, and it should be the business of some officer of the camp to see that this is done. It may not be possible to make up beds and carry water, but supervision can be given the camp to see that the beds are kept clean and free from vermin, and it should not be expected of a man who works hard all day to clean up a shack and sweep around the doorway after he has come to camp in the evening. Fuel should also be furnished him at a low cost for cooking purposes and heating. These items will not cost much during a year, while the money so spent will yield a large per cent of profit in satisfying employees, giving their best endeavors to their work.

Every camp should have a night watchman. He not only looks after the property of the contractor, but he sees that the men are protected. This is necessary as there have been occasions where men just after pay-day have been held up in large numbers in a camp and robbed of their wages. Men feel much safer in working in a camp where a watchman is employed. A night watchman will also see that men are awakened in the morning, first the cook and his assistants, then the superintendent and stablemen and then the other employees.

Good order and cleanliness should be kept in camp. For this purpose the night watchman can be made a sort of health and police officer. At times he can be made, through the proper officials, a constable or a deputy sheriff, which will be a great help. He can see that the buildings and grounds are kept tidy and in a healthy condition, and that all the boisterous and rowdy men are not allowed a free hand, so as not to molest those who wish to rest at night, or are peacefully inclined. It is better to get rid of a few rowdies than lose a large number of self respecting and hard working men. There should always be an hour set for men to cease their noise in camp, so that ample sleep can be obtained by all. Those who do not wish to retire at that time must be made to keep quiet, or if they wish amusement until late in the night, go outside the camp for it. Liquor should not be allowed to be brought openly into a camp, as it has a demoralizing effect.

When men are solicited to come to your camp, either personally or through labor agents, be certain that every detail is pictured to the prospective workmen as they really exist. Tell them of the wages and pay days, of the living expenses, the hours of work, should they ask regarding these subjects, just as they are, so that the dissatisfied ones can drop out before they start. One man grumbling, later means a large number dissatisfied. Above all things, don't use whisky to entice a man to take employment with you. The contracting business and whisky do not mix well.

Make only such promises to men as can be kept. Broken promises mean that men will quickly leave. It is a fact that few seem to realize, that as laborers only too often break their promises, they are quick to criticize others who may not do as they promise. A good rule is not to make promises; then none will have to be kept.

To make men feel that their comfort is being considered, do

not work them over ten hours a day, unless unforeseen difficulties arise, or the work has to be pushed, in which case overtime should be paid. Above all things so arrange the working hours that the men will start to work in daylight and stop work before it is dark. Place yourself in a laborer's place and see how you would feel not to have any daylight hours that you could call your own. To do this it may be necessary to change the time, but it is a common occurrence that the "camp time" is different from standard time.

The feeding of men must be done with care. Men must be well fed to work well. The day for a fare of "salt horse," black bread and coffee is past. A good variety of well prepared food should be furnished and frequent changes should be made. Desserts and other tasty things should be served, and everything should be neat and clean. Men working in a cold climate should be given plenty of meat and sweets to eat, while in a hot country plenty of fresh vegetables and fruits should be used. Good cooks should be employed, as they are the most economical in the end. Badly prepared food means waste. If the feeding of men is let out by contract, the contractor should give some supervision to it.

Always have a pleasant greeting for every person in your employ. A few minutes of pleasant chat to a gang of men now and then means little lost time to a contractor, but much to his men, and thus a gain to him. Men wish to feel that they know their employer, and much good can be accomplished in this way. Do not become familiar or hail-fellow-well-met with them, as this does away with all *esprit de corps*. Upon every occasion possible commend good honest work. When fault is to be found, have the matter disposed of quickly. Do not be a continual fault finder. This may make men afraid of you, but it does not get good faithful work.

### *The Welfare of Men.*

The welfare of men must also be looked after. Whenever possible amusements and diversions should be furnished them. A few musical instruments, such as a banjo, guitar, accordian and such like instruments kept in camp for the use of the men, will be found a source of much pleasure to them, and the cost will be nominal. During the winter evenings games of checkers, dominoes, cards and similar diversions will be found of much benefit. In summer, quoits, base-balls for throwing and catching, weight lift-

ing, single stick play and numerous other sports will be found attractive. At times various athletic sports can be indulged in, as jumping, running, wrestling, tree climbing and other exercises. Many who have not tried to interest their men with such sports may think that they will not enjoy them, and some will say that they get exercise enough from their work, but the author knows from experience that hard working men enjoy such things and are better satisfied with both their work and surroundings. The truth is, that men accustomed to hard physical work find that these various athletic games and exercises help to rest them by bringing into play muscles that are not used at work.

On holidays men work with greater zest, by being furnished with a finer meal than usual, or some special attention paid them. In the South, where negro labor is worked extensively, a dancing platform will afford the men much pleasure, and on certain nights in the week, especially Saturday, will be much used. Less liquor will also be drunk when the men's superfluous energy is used up in such harmless ways. Any contractor knows, that the less liquor his men drink, the more work he obtains from them. In fact, liquor is a great disorganizer, and men who drink excessively are not competent to handle and care for machinery; neither are they capable of doing a fair day's work.

Papers and books can be furnished the men at a small cost. Engineering and contracting papers are always read in a camp, and a daily paper is much appreciated. A few books give much pleasure. On short jobs extensive preparations cannot be made for a reading and writing room, but on jobs lasting some years there is no reason why such accommodations should not be furnished.

The government has done considerable work of this kind at Panama, and some contractors who have extensive work covering long periods of time, have gone so far as to establish banks for the convenience of their men. Also music halls where theatrical companies and others give performances have been established and proved paying investments.

### *Physical Welfare of Men.*

This brings us to another feature of the care of men. Anyone suffering from physical ailment or weakness is not competent to

work, and nearly every contractor employing large numbers of laborers always has men on the sick list. At times those disabled become so numerous that he is seriously handicapped. Outside of the sentiment in this matter, there is the hard business reason that men becoming sick and injured should be dealt with from a practical standpoint. Upon one occasion the author heard a contractor say that he had thirty men suffering with malarial fever, and as he was working about one hundred men on his contract, to have about one-third of his force on the sick list, was a serious problem.

Obviously the best way to prevent such things would be to have a doctor on the work. This may be both feasible and practical on such a job as a subaqueous tunnel, where the cost of not only a corps of doctors, but also a hospital, may be figured in the price of the work, or even on an extensive and long job, but for most work this is not possible.

First, it would be entirely too expensive, and in the second place most construction work is done in out-of-the-way places and in undeveloped country, where doctors are scarce. But it is possible to arrange for the attendance of a doctor two or three times a week.

In some sections of the country, this is customary, the expense of the doctor being borne by the men themselves, a small fee being deducted from the men's wages each month and turned over to the camp doctor, the contractor taking a percentage for keeping the accounts and guaranteeing the money. This fee also covers the cost of such medicine as a country doctor is accustomed to carry with him in his medicine case.

Now and then when the work is extensive, and the number of men being employed is sufficient, a doctor will temporarily give up other practice and devote all his time to the several camps that are maintained on the work. Such arrangements are good, and much sickness of a serious nature is thus prevented, but as the doctor usually visits the camps during the day when the men are at their work, he is only able to treat and give attention to those who are so ill, that it is not possible for them to be with their gangs. Thus, many men who are ailing, are ultimately laid up and put under the doctor's care, when a few doses of medicine promptly given would keep them from stopping work.

Then there are the men who are injured in various ways on

the work or in quarrels and fights. These things frequently happen when the camp physician is not within easy reach, and at times a man is so severely injured that unless he has prompt aid he may die from his wounds.

For these purposes a medicine chest or a miniature drug store should be kept in camp. Bandages, restoratives and other things for first aid should be kept on hand so as to care for the injured until a physician arrives. Chests with the necessary remedies for first aid can be purchased, but the author has been accustomed to provide medicines to treat minor diseases and slight ailments.

### *Medicine Chest.*

The following list has been found useful. The quantity to purchase at one time is given and also the uses of each medicine:

1 bottle phenol sodique (antiseptic)—Burns, gunshots, cuts, blisters, bruises, etc.
1 gal. turpentine—Cuts, bruises, sprains, colds, grippe, pneumonia, etc.
1 lb. witch hazel—Bruises, sprains, soreness of limbs, etc.
1 lb. Peru oil—For dressing cuts and various wounds
100 tablets Bernay T. T. No. 695—Washing and cleansing foul sores
2 lbs. hydrogen peroxide—For cleansing running sores
2 lbs. glykaolin or similar preparation—Frost bites, bruises, aches where skin is not broken, swellings, etc.
500 tablets 5 gr. Dover's powders—Colds, grippe, etc.
1,000 tablets Brown mixture comp.—Coughs, colds, etc.
1,000 tablets 1-60 gr. strychnine sulph.—As a stimulant after colds, bilious attacks, etc.
1,000 ½ gr. calomel tablets—Colds, fever, excess bile, chills, boils, etc.
4 doz. Seidlitz powders—In connection with calomel
1,000 quinine 2 gr. capsules (sulphate)—Colds, fevers, chills, etc.
1 lb. White Pine Tar Syrup—Coughs
2 doz. boxes of cough drops—Coughs
1 lb. glycerine—Colds, sore throat, chapped hands, foot sweats
1 lb. Squibb's Mixture—Diarrhoea, dysentery, colic, etc.
1 lb. soda—Sour stomach
1 lb. compound cathartic pills—Constipation
500 charcoal tablets—Sour stomach, heart burn.
½ lb. Jamaica ginger (essence)—Various stomach and bowel troubles
2 lbs. castor oil—Constipation, colds, etc.
5 lbs. Epsom salts—Constipation, headaches, etc.
3 oz. 5 gr. Aspirin powders—Nervousness, pains, rheumatism, headache, especially when caused by working with dynamite
Peroxide of hydrogen (antiseptic)—Cuts, etc.
500 5 gr. Antikamnia—Headache, neuralgia, etc.
1 doz. bottles bromo seltzer—Headache, etc.
4 oz. Acetanilid—Headache, neuralgia, fevers, etc.
1 lb. cream of tartar—Painful or scanty urine
1 lb. spirits of nitre—Urinal trouble
½ lb. spirits camphor—To settle stomach after vomiting
¼ lb. sweet oil—Earache
½ lb. laudanum—Earache, stomach and bowel complaint

2 oz. oil of cloves—Toothache
½ lb. boracic acid—For prickly heat, etc.
½ lb. salicylic acid—For prickly heat, etc.
2 boxes DeWitt's witch hazel salve—Chafing of legs, boils, etc.
1 lb. borax—Sore and tender feet.
100 tablets morphine and atropine No. 2—For hypodermic syringe
1,000 empty capsules No. 2
1 lb. chloroform or ether
2 lbs. absorbent cotton
2 lbs. cotton bandages
4 yds. Linton Worst gauze
1 in. adhesive plaster, 2 in. adhesive plaster, 1 yd. Belladonna plaster
½ lb. carbolic soap
1 lb.carbolic acid—For accidents such as gunshots, explosions, falls, and injuries from machinery
½ lb. Cheeseborough vaseline
2 boxes of mustard plasters
1 hypodermic syringe
1 hard rubber syringe.
1 doz. medicine droppers
2 pairs of dentists' forceps
1 doz. surgeons' needles
6 cards surgeons' silk
Surgeons' sutures
1 case knife
2 small surgeons' scalpels
2 small pairs of surgeons' tweezers
2 hot water bags
6 rubber bandages

With such drugs on hand many men suffering only from slight ailments can be doctored at night, after the day's work has been completed, or in the morning before starting for work. In this way the men are kept on the work and are not loafing around the camp, becoming dissatisfied with their surroundings and causing trouble for those at work.

Any intelligent men, under the camp doctor's directions can administer these drugs, and soon learn what to use for various disorders and the dose to be given. If a hospital is established on the job, the drugs can be kept at the hospital. On jobs lasting a year or more the drugs can be kept on shelves in the office or commissary, but when frequent moves of the camp are made, a medicine chest to hold these drugs can be made, and they can be kept in it.

Whisky should not be kept as a medicine in camp, for it is quickly used up and there is really no need for it unless prescribed by a doctor. Men sometimes suffer severely with headaches, either from handling dynamite or from the odor of the fumes after an explosion. Such headaches can not only be cured

by aspirin, but men can be prevented from having these headaches by using this drug.

Every morning and immediately after the noon hour, visits should be made to the men's shacks to look up the sick for treatment, so that they will be well enough to go to work that afternoon or the next day. The men will appreciate such care and they will speak of it to their friends, thus attracting other men to the camp.

### *Labor Laws.*

Contractors should not oppose labor laws unless they are drastic in their action. However, the various contractors' societies should see that such laws are made equitable. A law compelling only eight hours of labor on contractors' work does not injure contractors unless it affects old contracts. On new work the extra cost can be figured in the price. The same is true of workmen's liability and compensation acts.

Eight hour labor laws allow a day to be divided into three shifts and men can be made to do more effective work in a short day than in a long one. Overtime is saved and the forces can be better organized. The men are also given some time for recreation, and in cities where such laws are especially applicable this means better work from the men.

Laws to protect workmen's lives are also a good thing for contractors, as proper safeguards are used around machinery and the work, saving money to contractors in the end.

Contractors should not only see that such laws are properly drawn, but should also be active in obtaining legislation to protect themselves from abuses, both from workmen and owners.

### *Wages of Men.*

As all men are working for wages this is an important matter to them. It is likewise of importance to contractors and one of the uncertain factors of contracting. In past days cheating men of their wages has been prevalent, but contractors have learned that this does not pay, and today men are being treated more fairly.

A system of time-keeping and paying men should be used that prevents men from robbing their employer, by means of

raising wages, and by dummies on the pay roll, and one that also guarantees to all workmen full pay for the time employed. Mistakes are a bad thing in a pay roll, but if they are made they should be rectified promptly. The subject of wages is treated at greater length elsewhere.

### *Efficiency of Men.*

Estimating labor efficiency is and probably always will be one of the large problems contractors have to face, particularly when undertaking jobs of any size. Many things affect the efficiency of men. When work is plentiful men do less work in a day. In a large construction undertaking this alone may mean decreased efficiency from workmen. High wages also means less work from men.

One large company employing many men in a community, with incompetent management and a loose system of handling men, may mean to affect the efficiency of workmen in that line in the entire community. The author has known this state of affairs to exist.

Labor unions likewise affect the efficiency of men. The attempt to set a common wage means to add to the cost of work done by the laggards, and has a tendency to make the good men do only as much work as the poor ones. Labor unions do not limit the amount of work that a man can do in a day; yet it is a fact that in the same line of business, in different sections of the country, the amount of work done by union men varies exceedingly.

The weather likewise affects the efficiency of men. Numerous other conditions also play a part in this. Contractors, in order to keep the efficiency of their men up to a standard, must employ all means possible and study closely the management of men.

# CHAPTER VII.

## CONSTRUCTION CAMPS.

### *Advantages of a Camp.*

FOR NEARLY all construction work, outside of cities and towns, a contractor should have a camp large enough to accommodate his men and teams. Some contractors claim that a camp is not necessary, but money can be saved by having one.

The advantages of a camp are many. The administration office of the contractor can be located on the work or along the line of the work. Shops for the repair of tools and machinery can be put up to make quick repairs and prevent breakdowns. The men can be furnished with comfortable quarters, and, by means of a "cook shanty," can also be properly fed. A store commissary can be operated for the benefit of the men. More work can be done, as the men, when wanted, can be found. Proper care can also be taken of the men; they can be kept from carousing, and the contractor can see to it that they get enough sleep. Men in a camp can be gotten up early enough so that they get to work on time. The proper care can be given to horses, and they, too, can be gotten on the work promptly.

When men have to board around in country houses it is often difficult for them to obtain board, and they finally become so scattered that much time is often lost by them in reporting late for duty. Then, when the weather is inclement, especially early in the day, many of the crews will not report in the morning, and, if during the day it becomes possible to start the work, it cannot be done on account of not having the proper help. The author has known this to happen quite frequently.

The care of men on contract work is a very essential feature, and the first requisite in order to give them proper care is a good camp.

*Selecting a Site.*

Considerable thought and judgment must be shown in selecting a camp site. The camp should be located close to the work, and yet not so close that men can steal away from their gangs and hide themselves in the camp to avoid work. This is often done when men are working at night, and sometimes on day work. The author has known laborers, as well as foremen, to do this. He remembers having a record of the time one foreman stayed in camp, leaving his men in charge of a sub-foreman. During one week this foreman spent nearly a fourth of his time in the camp.

In building a railroad the camp should be located close to the line of road and, if possible, centrally, so that the walk to work in both directions along the line is about the same. Camps should be located, if possible, close to good springs. The spring should be cleaned out and a box, barrel or pipe placed in it, so that it can readily be kept clean. If possible, a small brook should run through the camp, as this way flowing water can be obtained for the horses and mules. Water can be taken from the brook by means of a pipe, run into troughs; the waste being run back into the brook lower down. If a large stream is not handy so that men can bathe in it, then a bathing place can be made in the brook by digging out a small pit or reservoir. Whenever possible, arrangements should be made so that workmen can bathe, and often this can be done most economically in selecting the camp site.

Another consideration in selecting a camp site is to get it on a knoll or hill, so that there will be the proper drainage, and the shacks or houses will not be flooded in prolonged rain storms. However, care must be exercised not to locate the camp where it is difficult to haul supplies to it, or where men will have to climb a steep hill or mountain going to or from their work. Men object to such things, and the author has known of cases where men refused to work for a contractor simply because the location of the camp was such that a hard climb was necessary at the end of the day's work. To start to work with a fatiguing walk is not objected to as much as to have it at the end of the day, but both should be avoided by the contractor in locating his camp.

A camp situated on low ground is frequently unhealthy,

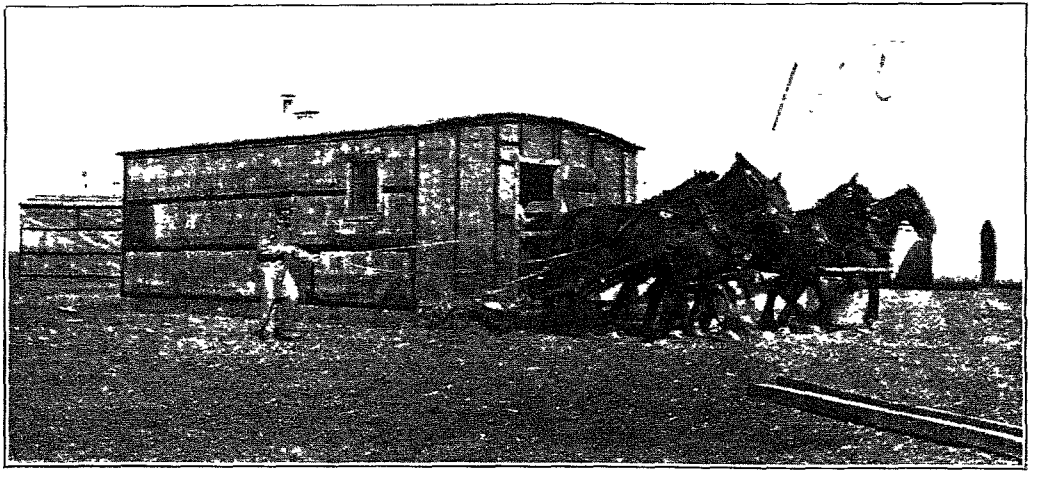

Fig. 2.—Skidding a Shack with Teams

keeps muddy, and is undesirable from many standpoints. In prairie country there is little choice of location for camps. One place is about as good as another, the only consideration being the distance from the work.

In mountainous country it is sometimes very hard to find a good site without doing considerable grading, unless the camp is located on the side of a stream which the railroad, canal or other structure may be following. It is bad practice, however, to locate a camp on a mountain stream on the opposite side from the work. A bridge must be built, or a ferry maintained, and, in times of high floods, which come frequently, the bridge is often washed out or the ferry put out of use so that it may not be possible to get to the work for several days at a time. Such an arrangement is also dangerous. The writer has known of several men losing their lives in crossing such streams under these circumstances.

### *Moving Camps.*

On some classes of work, especially on light work which extends over a long distance, it is necessary to move camp frequently. Such camps must be arranged and constructed differently from those meant to be more permanent. In many cases it is much cheaper and better to use tents for camps, although there are times when board "shacks" can be used. In rough country tents are to be preferred, as they can be moved more easily. This is particularly important if camp is to be moved a considerable distance.

Shacks can be used readily, even when the camps must be moved often. It is possible to build small houses of lumber in sections so that they can be taken apart, hauled and set up again. A contractor can have such houses designed and built. There are several companies who manufacture and sell collapsible and movable houses, and besides having stock buildings, will get up special buildings to suit their trade. In most cases such houses will be found much more serviceable than those built by a contractor, as these companies, having had great experience with this class of buildings, construct them better. In addition to this they often own or control valuable patent fixtures, fastenings and similar things. Such houses, like tents, can be carried from one job to another. See Figs. 3 and 4. These houses are often built

of galvanized iron, and are meant to be fire proof. Such a house is suitable for the storage of oils and for use as a garage.

Where the ground is comparatively level and the moves to be made are a mile or less, a regular shack can be built and moved wherever necessary. Such a shack must, however, be built very strong. It must have good heavy timbers under it, and a substantial framework of scantlings. Figure 2 is an illustration of such a shack being moved with horses. This building has, in the framework under it, three pieces of 6x6 inch timbers running lengthwise. These timbers act as skids to move the shack upon. The ground being smooth, the horses can pull the building along on these skids, one skid being on either side of the house and the other under the center.

When the ground is rough it is frequently necessary to lay down heavy planks to move the houses. The plankings should be well greased with cheap car or wagon grease. At other times it is necessary to lay down planks and to use rollers in order to move the houses readily, but this results in slower work. For this work a windlass is generally more economical than horses. Traction engines can also be used for moving such shacks.

*Dugouts.*

Board shacks are in many ways the most comfortable temporary buildings that can be made; but it is not always possible in mountainous sections of the country, or at points far from civilization, to obtain boards, and other classes of buildings must sometimes be built. In some places where trees are scarce and only small poles and brush can be obtained, dugouts are often built. For these a hole the size of the building is excavated and lined with stones or small logs and brush—preferably with stone. Over the top a few poles are laid, and then plenty of good brush. Over this is placed a foot or two of earth. The front is then built up out of the best available material, and a fairly comfortable house is provided. Such dugouts are often built, even where boards can be gotten, for keeping meat and vegetables, and also as magazines for the storage of explosives.

*Log Houses.*

When large logs are plentiful, log huts can be built. The logs are cut and sawed to the proper length, and notched at the

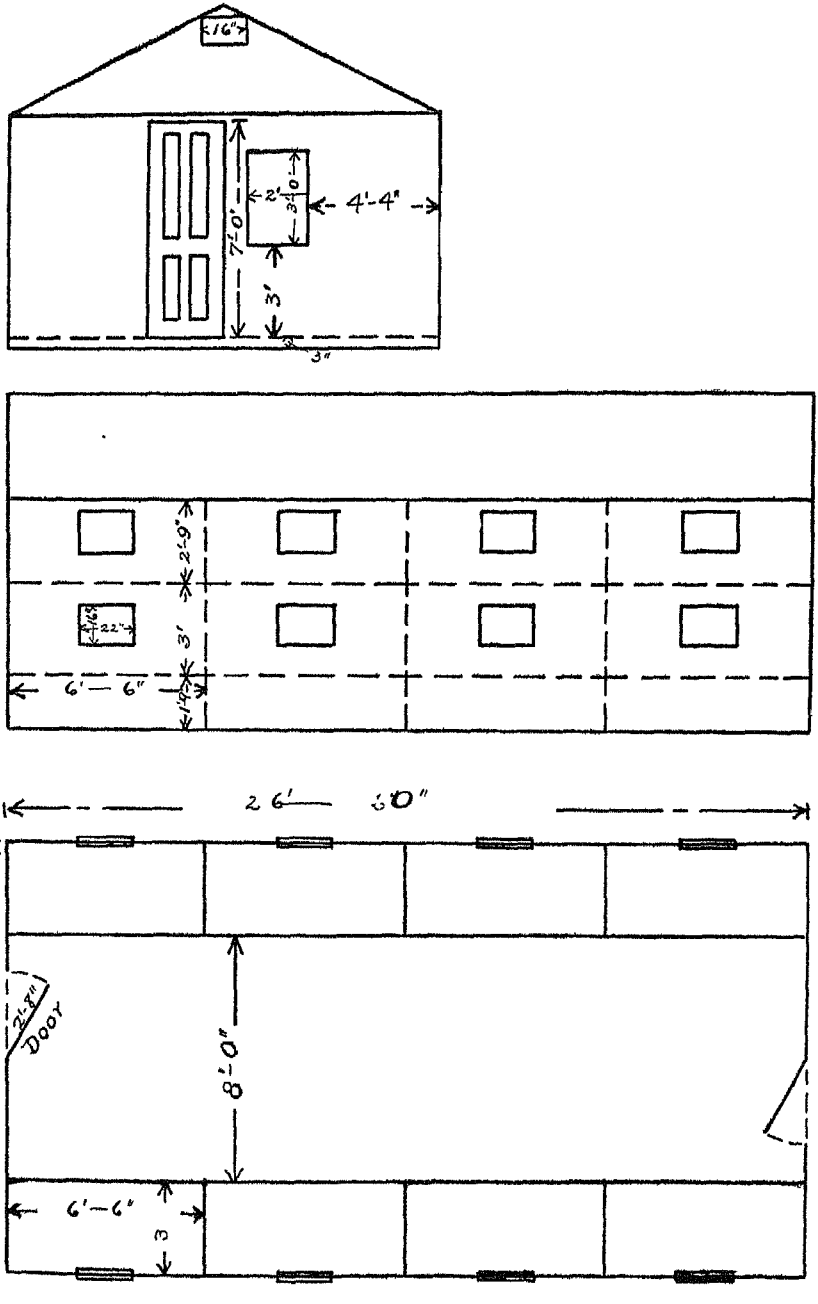


Fig. 3.—Portable Bunkhouse.

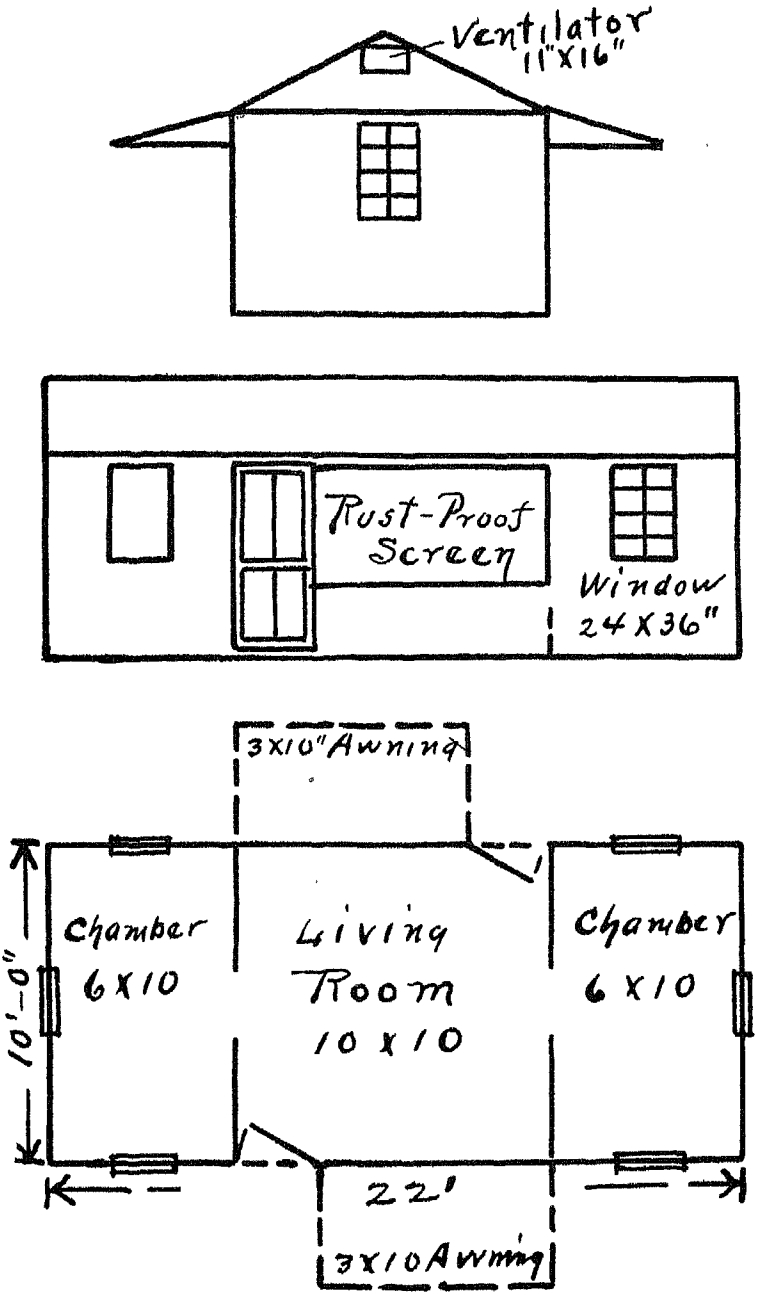


Fig. 4.—Three-Room Portable House.

ends, where they rest one on the other. After erection they are clinched with small pieces of wood, split up much like firewood, and after this a plastic clay is mixed with water and the spaces between the logs filled and troweled over. This makes them watertight and warm. For the roof, rafters of logs are laid, and so-called "boards," about twice the size of an ordinary shingle, can be split out of straight grained logs and laid on the rafters much like shingles. The rafters for this must run at right angles to the "boards." Tar paper and similar roofing material can also be used. It is possible to make a roof for a log hut similar to that for the dugout, but these often leak during heavy rainstorms or when the snow melts.

### *Brush Houses.*

Italian laborers build many makeshifts for houses. Some of them are in the form of a "lean-to" against some other building. Some are small A-shaped houses built against a ridge pole, while others take any shape the builder is able to make out of the material he has at hand. Such shacks are made of logs, poles, brush, dirt, pieces of boards, old roofing, old powder cans straightened out, or any other material the builder can beg, borrow or steal. Such shacks are of the most temporary kind, and during bad weather, or in the winter, are very uncomfortable abodes. They are unsightly and ruin the looks of a camp. During inclement weather the men cannot rest well in them, nor is it possible to dry clothing or shoes. A contractor does well to prohibit the building of such shacks, as men who live in them will not do as efficient work as those who are properly housed. See Fig. 5.

It is well to know of these things and to know how to build such shacks, as there may be times when such temporary quarters must be built and used until materials can be obtained for better buildings.

In warm countries, during the hot weather, quite a comfortable lounging place can be built in front of a shack by using four poles, placing small pole rafters on them, and covering with brush. From time to time the brush can be renewed. In excessively hot weather these protections can be used for sleeping quarters, and will be found much cooler than the shacks themselves. A much better cover can be made of canvas, which can be used during successive seasons.

### *Sleeping in the Open.*

For sleeping out in the open, the best thing is a sleeping bag. These bags can be bought, and even in very cold weather will be found as warm as any bed in a house, the only discomfort being in undressing and dressing. A very good sleeping bag can be made by anyone from canvas. There should always be a flap of the canvas so arranged that during a rain or snow-storm it can be pulled up over the face. The face can also be protected from storms by building a framework about three feet square and three feet high. This can be made to fit over the body and rest on the ground. The top, back and front can be built of boards and covered with some kind of roofing. The two sides can have heavy canvas curtains hung on them. Then one curtain can always be kept open in the storm, dropping the curtain on the side from which the snow or rain comes.

For sleeping in the open a sleeping bag is the best arrangement, but there are substitutes. Several poles or logs can be rolled and placed so as to make a bed of a few blankets between the logs. The logs prevent the wind from getting under the blankets. Rocks so placed are a help, but are not as good as logs. When dry dead leaves can be obtained, a good bed can be made of these, as well as of hay and straw. Other expedients will suggest themselves to those who may be unfortunate enough to be out in the open without the proper camping outfit. One such expedient is a barrel. An open fire is built, and without any bed clothing a man can keep warm with a barrel. He lies on the ground with his feet towards the fire, and puts his head in the barrel, of which only one end has been knocked out. The barrel collects the heat from the fire and keeps his head and body warm, while his feet and legs are kept warm by the fire.

### *Board Shacks.*

Camps which are meant to be used for a year or two and then abandoned are quickly and cheaply built of rough boards and small scantlings. Such shacks are built of various sizes and designs and many of them are sightly and comfortable. It is easy, however, to add details that increase the cost without adding to the convenience of the building. Naturally,

Fig. 5. View Showing Makeshift Shacks.

each contractor or superintendent will build according to his individual tastes and opinions. One of the greatest differences in building shacks is in the roof. The shack illustrated in Fig. 2 has what is known as the round roof. This is a favorite roof, and has several factors in its favor. Some framing is saved in the roof, as only three pieces of scantlings are needed, one on each side of the shack and one in the center. The middle of the board is nailed to the center scantling and then each end is bent down and nailed. Special and extra work is necessary to give the two ends this rounded appearance, and the end boards must be longer than the side boards. If the shacks are covered with tar paper there is also waste of tar paper.

Flat roofs are not much used for camps as they are seldom built steep enough to allow rain water to run off quickly. When covered with melting snow they often leak. Another objection to this form of roof is that in order to give the shack sufficient width, a long scantling is necessary for a rafter. This makes the lumber higher in cost, and weakens the roof under a snow load. Flat roofs nearly always sag in the center after they have been built a few months. Boards for the sides of the shacks vary much in length, which, in the author's opinion, is a serious objection.

The peaked or gable roof is in many ways the best roof for a board or log shack. There is slightly more work in framing the scantlings or rafters, but this is more than compensated for in other ways. Much better ventilation can be arranged with this kind of a roof. In fact, the roof space, to some extent, acts as a ventilator. It is an easy matter to arrange a small cupola in the center for ventilation; or at the two ends, small ventilating windows can be placed at the peak of the roof. The roof space can also be used as a storage place, and men living in the shack find this a great convenience.

The ordinary method of building shacks for camps is to lay down the bottom plates on the spot selected for the building. As level a space as possible should be selected, as the closer the building is to the ground the warmer it will be. If to get a level spot necessitates too much grading, then the plates can be leveled by means of stones, short posts or blocks. On the plates the floor beams are laid and the framing for the sides of the building is erected. Then the framing for the roof is put in place. Meantime the boards are nailed on the sides, the boards running at

right angles to the framing. The floor itself need not be laid until the last thing.

This is an expensive way of building a shack that does not have to be moved. A more economical method is first to lay the plates and the floor beams and lay the floor at once. This makes the base rigid and also permits the floor to be used as a working platform. Next a wall plate is framed, and for a small building, is nailed together. Then two good boards are selected for each corner of the shack and nailed together so as to make the corner. The corner boards are nailed to the base and then the wall plates are raised and nailed to the top of the boards. Finally all the side boards are nailed on, these boards running vertically. Openings are left for the doors and windows. Thus the side boards of the building act as framing and the building is strong enough for all purposes, while considerable lumber is saved. For the sides 14-foot boards are secured and cut in half. This gives a shack a little more than 6 feet high on the inside, as the floor takes up from 6 to 7 inches of the 7 feet. Fourteen-foot boards can be bought cheaply, are easily handled, and more can be hauled to the load than longer lengths. For general use shacks with 7-foot sides are of ample height, and such shacks are easily heated.

The roof framing is next placed, the rafters, 2x4-inch scantlings, being laid on from 3 to 6 feet centers, according to the snow load they may have to carry. For a peaked or gable roof of a building 15 feet wide, and a 4-foot rise at the center, 10-foot scantlings make excellent rafters and give ample overhang.

This size of scantling is readily obtained and is easily handled and hauled. An economical rule for buying timber is always to buy as short lengths as possible. Long boards and timber cost extra money.

The peaked ends of the building between the top wall plate and the roof can be made of small ends of boards that might otherwise go to waste. For the roof boards, use the cull of the timber, as the roof is always covered with other material.

Split boards can be nailed together and used as ties across the building on the top wall plates. This will strengthen the roof and give a support for boards to be laid and used for storage in the roof space. As this storage space is less than 7 feet from the floor it is easily reached.

Shacks built up in this manner cannot be moved from place

to place, except by tearing them down; but for ordinary use they answer every purpose, and they are economical to erect, both in labor and material.

The doors and windows in shacks are of importance. Doors in the commissary, supply houses, warehouses and such buildings should never be less than four feet wide. A four-foot door can be hung on strap hinges, but if it is made wider, then it is well to put it on rollers and slide it back and forth, instead of opening it by swinging. It is well to remember that heavy and bulky bales, boxes and barrels must be taken through such doors, and they should be of ample width to handle the goods readily. Very wide doors should not be made of two pieces, especially when teams back up to them, as they are easily broken. They can also be opened more easily than sliding doors in case burglars attempt to enter. A sliding door should be hung on the inside.

For living shacks a door 3 feet wide should be the standard. Doors 2½ feet wide can be used for small shacks, but the objection to them is that a trunk can not be taken through them. The doors of shacks should open outwards, as room is saved on the inside; this especially applies to doors made from ordinary boards. Such doors, in addition to having two battens across them, should have a batten or brace running between the two horizontal battens, and from the back edge of the door at the bottom to the front edge at the top. This is necessary to prevent the door from sagging at the front edge.

For living shacks, one window sash will do for a window. This can be made to slide back and forth, and should be placed in the side, near the roof. The window then aids in ventilating and people cannot look into the shack so easily from the outside.

In the office, kitchen and dining room, windows of two sashes can be used, as more light is needed in such shacks. For a commissary, warehouse or storehouse the author does not use any glass windows. In the oil house, if it is to be used during the winter, a window sash is used. For summer use only, a window is not necessary, as all the light needed can be obtained by opening the door. In the winter time a fire is needed to prevent the oils from congealing.

*Commissary and Office.*

The author always builds his commissary, office and a sleeping room for a few of his principal men in one building. The

commissary has a large window from 6 to 10 feet long and 4 feet wide, and this is hinged to open outwards and up. This is opened by means of a rope and pulley fastened to the roof. When opened it acts as a guard to prevent rain and snow from blowing into the opened window, and also as a protection for men to stand under. A counter is built against the side of the shack at this window opening. The men, in order to purchase, do not enter the commissary. The commissary is so built, and this counter is so arranged, that a man standing on the outside cannot readily reach in, but can easily look in at the display of goods. A man standing on the outside under the shelter of the window with his shoulder about even with the counter cannot readily attack the commissary clerk.

Some contractors have a counter on the inside of the commissary building and allow the men to enter to purchase goods. The author objects to this, as many small articles are stolen in this way. He has also known of cases where clerks, timekeepers, and even contractors, were stabbed by dissatisfied men with the cheese or meat knife, or were knocked senseless by some laborer with the weights of the scales. With the men on the outside and the window so high that they cannot reach in, these things do not happen. If trouble does occur, those on the inside have the advantage in being higher up than the men outside, and if pistols are drawn they can protect themselves by dropping the window. In fact, this very window becomes a weapon in their hands. These things may seem unimportant, but they may be the means of saving some trusted employee from serious injury or death.

*Living Houses.*

Low-roofed shacks meant for living purposes should have some kind of a ventilator; but in a shack having a peaked or gable roof, as described above, a ventilator is not needed, especially if the windows are near the roof.

This style of shack, built with boards running vertically, need not have the cracks between the boards stopped up during the summer. But before winter sets in, all cracks must be covered. In this style of shack the cracks can be stripped with 2x1-inch strips. With shacks built with studding the boards generally run horizontally, and the cracks can be closed up well only by cover-

ing the buildings with tar paper. As a rule a building can be stripped cheaper than it can be covered with tar paper. Stripping is all right in the south, but in the far north it is not warm enough for winter, and all buildings used for men or horses should be covered with tar paper.

### *Covering and Roofing.*

Tar paper for covering the sides of the buildings need only be 2-ply; and if the buildings are to be used but one season 1-ply paper can be used. For roofs 3-ply paper should be used, as the sun affects it, and leaks occur even with the 3-ply paper. If the shacks are built in the fall of the year, tar paper roofs without being painted will last through that winter, the following summer and the next winter, but if the buildings are built in the spring the tar paper will seldom give good service during the second winter. In other words, the heat of the sun from two summers takes the life from the paper. If buildings are meant for use for as long a time as this the tar paper should be painted, as then it will last for a number of years.

Tar paper, however, can seldom be taken off of one building and put on another, as it breaks from being handled. The old method for attaching the tar paper to the building was by means of small roofing nails and tin caps. Money can be saved by using the capped roofing nails, thus doing away with the tin caps. These hold better and save considerable labor in tacking on the paper.

As there is no selvage in tar paper, it would prove economical in some cases to use other prepared roofing that comes in rolls, similar to tar paper. A roofing that can be taken off without injury and used again will give more satisfactory results, and in the end will prove cheaper. To take off such roofing a small strip is cut off of each side, where the nails go through. Thus each time the roofing is used the strips become narrower.

In building shacks for camps too many nails are used. Two nails in each end of a twelve-inch board are sufficient, yet carpenters will insist in using three and four. Most of the boards should be fastened with 8d wire nails, but some 10d nails should be used. For the framing some 20d nails are needed, and sometimes a few 30d or 40d.

### *Heating Houses.*

In the winter time shacks should be well heated, not only for the comfort of the men, but also that they may dry their clothing and foot wear. When it is necessary wood will do for fuel, but it is fairly expensive. In most cases it is green, and does not burn well. The cost of hauling it, and of cutting it up, even if one does not have to pay for the wood, amounts to a dollar or more per cord. When coal can be obtained for $3.50 or less per ton it is better to use it. There are places, however, where wood is cheap and coal cannot be obtained except at an excessive cost. Light, cheap stoves should never be purchased for camps. All stoves, whether for wood or coal, should be of simple design and plain, and should be of heavy cast iron. The feet should be low and strong. Stoves should be set in a box filled with sand or dry clay. This prevents fires and keeps the space under the stove from being littered with tobacco ashes and cigar stumps. Where the stove pipes go through the building a sheet of tin or sheet iron, or terra cotta tile, should be used to prevent fires. For heating stoves do not run the pipe through the roof, as rain and snow are likely to beat in, and much heat escapes through a straight pipe. A damper should be used, and the pipe should have an elbow in it and run through one end of the building. Then most of the heat can be retained in the building. In mountainous sections, where hauling is expensive, shacks, and especially log huts, can be heated by open fire places. Large fireplaces and low chimneys can be built of stones and clay, or even of clay and small poles and sticks. One advantage a fire place possesses over a stove is that the wood does not have to be cut so short or split as much.

### *Lights in Camp.*

The lighting of a camp should also be given attention. Large lamps of some kind should light up the entire camp area. This allows good order to be kept at all times. For this purpose the author has used Dietz's street lamps, which will burn all night. When a power plant is used on the work, such as a compressor, then electric lights can be installed, and not only the camp itself be lighted in this manner, but also the shacks. Without electric

lights the shacks can be lighted either by hanging lamps or by bracket lamps on the walls. Hand lamps should not be used, as they are too liable to be knocked over. If a man wants a light of his own, sell him a lantern and the oil for it, or keep candles for sale. As a rule, when a candle is knocked over it goes out, so there is little danger from it.

### *Drinking Water.*

Good drinking water should always be supplied. This can generally be done from springs. Men should not be allowed to drink water from a stream or river, as sickness is likely to occur. If spring water cannot be obtained, then a well can be sunk. The cheapest well is generally a square one, and it can be curbed with boards. If a well must be taken to any great depth, then dry points can be used, except in an arid country. These dry points can be driven into the ground a short distance, connected to the surface with a pipe and a small hand pump placed on the pipe. As a contractor, as a rule, has pipe, the only extra expense he is put to is the point and the pump.

### *Arrangement of Camp.*

Ample arrangements for closets should be made for the men, away from the water supply. The men should be made to use these closets.

The size of the camp buildings depends to some extent upon the nature and length of the job, and upon the arrangement of the shacks. The commissary, if one is used, and the office, should be located in a commanding position. A full length window should be placed in the office and the desk of the man in charge placed at this window, so that as he sits at his desk he can see the kitchen and mess room. The latter building should be so located and built that all doors to it can be seen from the office. This will prevent much waste and stealing in the kitchen. The blacksmith shop should also be located so that it can be seen from the office window. This will prevent men from loafing in the shop and from taking tools and supplies from it without permission.

The shacks for the foremen should be near the office, and

if possible just behind it, so that if any trouble occurs in the camp the foremen will be within easy reach. The stable should be off to one side and as far away from the kitchen as possible, so as to reduce the nuisance of flies to a minimum. The tool, supply and warehouse should be near the office and commissary. The author builds them as a part of that building when possible. The oil house is placed at a convenient place, where the danger of fire is not great. Any building to which supplies must be hauled should be placed as near the road leading to the camp as possible. This means money saved in hauling and unloading. The powder magazine should always be located away from the camp, in a safe place, and whenever possible under the lee of a hill. Brush, dry grass, logs and all inflammable material should be cleaned from around it.

The author builds all of these buildings 15 feet wide, and of such length as is necessary, with the exception of the blacksmith shop, and on some jobs, the oil house. The oil house on a large job is built the same width, but on a small job on which but a small amount of such supplies are used, it is built much smaller. The blacksmith shop is built about 15 feet long and 8 feet wide, with a flat but high pitched roof. The front is either left out or made to open, so that large and long tools can be easily handled at the anvil and forge.

Some care and judgment must be used as to the location of the shacks for the various classes of laborers. If negroes are worked they must be separated from the whites, and if foreign laborers are employed they must be kept away from the other men, and each nationality provided for separately.

The higher class of laborers should be housed by themselves; steam shovel crews as one class, dinkey runners as another, hoisting engineers as a third class, and so on down the list. Common laborers should always be put off by themselves.

As to the size of shacks, they should, as a rule, be built to accommodate four men. A few shacks may be built for six and eight, but men object to being put in large numbers into one building. The author, working day and night shifts, has had eight men in a shack, four from the day crew and four from the night shift.

The author always builds one shack off from the others and uses it for men until some severe sickness breaks out in the camp,

when it is converted into a sort of hospital and the sick ones isolated there.

Even negroes object to living in large numbers in one building. Shacks to hold over four should not be built for them. These will accommodate four men, or one man and a woman. However, it is well to have one large building to hold from 25 to 50 men, as then there is always a place to put a large number of new men that may have to be brought in and housed until they can be grouped off and put into smaller shacks. Such a large shanty is called by the negroes a "bull pen." Foreign laborers are much easier to hold in large buildings, but many Italians prefer small shacks. Austrians go in messes of from 10 to 25 men, and each mess wants a building in which they can sleep, have their meals cooked, and eat.

For the best class of laborers small iron beds can be furnished, or movable bunks built on which springs and mattresses can be placed. For common laborers always build bunks large enough for two men, as each laborer has a "buddie" and they prefer to bunk together so as to share their bedding. Either straw or ticks with straw in them should be furnished the men to sleep upon. A comfortable night's rest means a good day's work the next day.

### *Camp Rent.*

Rent is charged the men for the use of the shack and the charge should not only be large enough to cover, during the life of the job, the cost of the building, but also the bedding, fuel and light. When men are boarded the shack rent should be included in the charge for board, but it should be separated so as to credit camp account with its share and the board account with its proportion.

### *Recreation Space.*

In every camp, space should be furnished for recreation purposes: playing ball, throwing horseshoes and heavy rocks, wrestling, running and similar sports. A dancing platform is often the source of much pleasure, and provision should be made to sell some refreshments during the dances. It is not well to allow more than two dances a week and a time must be set to close them. Such a platform can also be used for boxing, and with proper restrictions

this sport will afford much pleasure to the entire camp. Boxing gloves should be kept for this purpose.

### *Camps in Cars.*

Camps for work along the line of a railroad and for track and bridge work can be made in cars. These camps, although a little high in first cost, are very economical in the long run, as they can be moved when desired, saving the cost of building a large number of shacks, and of moving and erecting camp. Such camps can be made very comfortable.

Old box cars and coaches can be bought and rebuilt to suit the needs of the men. One car can be fitted up for an office, one for a commissary, and one for kitchen, or for a kitchen and mess room together. One car can be made into a tool and oil storage, while others are fixed up for sleeping quarters for the men. The cars should always be well ventilated, but the ventilators should be so arranged as to provide ample clearance in passing through tunnels. Such cars are not only cheaper than shacks, but they form a permanent investment instead of a direct expense against each job.

### *Camp on Wheels.*

For some classes of work, especially when only a few men are employed, camp shacks can be built on wheels and readily moved from place to place, either by traction engines or by horses. They can be arranged much as the camps in cars, but need not be quite so elaborate.

### *Tents for Camps.*

Tents and canvas are much used on construction work in some sections of the country, but in other sections they are rarely seen. Under many conditions they are economical for camps, and also as protection against the weather for materials and for parts of the work that may be injured by exposure to the elements.

Tents make excellent living places in camps. They are ideal for warm climates and yet they can be used during cold weather. A tent set up in the protection of evergreen trees or, in very cold countries with snow banked around it to cut off the wind, can be

easily heated by keeping a fire going continually; but naturally much heat is lost by radiation. But when the fire is allowed to die down, the tent soon becomes as cold as the air outside. One can live comfortably in a tent during the winter in almost any part of the United States. The author has lived in a tent with the thermometer as much as 15 degrees below zero. Horses and mules can be kept in tents the year around without hardship, if the tents are properly arranged.

### *Vermin in Camps.*

Tents for construction camps are as a rule more sanitary than board and log shacks. They can be aired more easily, and while sleeping the men can be given plenty of fresh air, making them more fit for work the next day. This is especially so when a large number of men must sleep in one place. Few shacks can be given proper ventilation. In addition, tents can be kept free from vermin more easily than shacks. Fleas are very hard to get rid of either in a tent or shack, but a flea will not stay on an exposed white surface long, so that the tent has this advantage over a board or log. There are sections of the country where fleas will always stay in camps, but they can be kept out of the sleeping quarters by spreading fresh leaves from walnut trees on the floor every few days. Where walnut leaves cannot be obtained, other leaves with a pungent odor can be used.

Other vermin quickly collect in shacks, however, and it is almost impossible to get rid of such pests, especially lice; but in the tents this can be readily done. The tent can be easily moved to a new place, and, if necessary, it can be dipped in hot water, thus killing the vermin. It is no trouble to do this for small tents. It can be done for large ones by digging a pool about a foot in depth and filling it with water; then heating the water by means of pieces of iron or stones. The tent, however, must not be put in the water until after the stones and iron, as it is apt to be injured. The canvas can be dried by spreading it out on the ground.

### *Moving Tents.*

Where camps are to be pitched only for a few weeks or a month or two, tents alone should be considered, as they are quickly erected and easily taken down for transportation to a new

site. The author has moved a camp for about 150 men and 120 horses a distance of five miles in less than 10 hours, using a small force of movers. This camp consisted of a canvas corral for the horses, 5 large tents, and about 12 small ones. The job should always be done with order and system, for speed and economy. One would be surprised to know how cheaply the large tents owned by our circuses are set up.

Tents are also cheaper than shacks when the camp is to be used six months or a year. A 9x12 foot shack will cost for labor of erection alone more than half as much again as a tent of the same size of 10 oz. army duck.

*Canvas for Tents.*

The canvas of which tents are made varies much in quality. Most tents are made of canvas 29 inches wide, which is spoken of in terms of weight. Thus, a 10 oz. duck is a yard of canvas 29 inches wide that weighs 10 ounces. For tents, canvas varying in weight from 6 to 20 ounces is used, although in most cases the heaviest is 15 ounces. The most common weights used are 8, 10, 12 and 15-oz. canvas. The grade known as "army duck" is one of the best and gives better wearing qualities. Other grades used are single filling duck and double filling duck. A 10-oz. double filling duck is about equal to an 8-oz. army duck.

The top of a tent is often made of heavier canvas than the walls. For instance, in small, light tents, the top is made of 8-oz. duck, while the walls are only 6½-oz. duck. Money can be saved in this way, and the tent will last about the same length of time. For tarpaulins and covers, 18 and 20-oz. duck is used.

Nearly every manufacturer either waterproofs or mildew-proofs his tents. This is an added protection to the tent, especially if pitched under trees where they easily become mildewed. Some canvas is made waterproof with paraffine, but in most cases some compound is used. Most manufacturers keep their formulae secret. Some tent makers sell their waterproof compound, so that it can be put on tents each season. Waterproofed duck can be obtained in tents now on the market. It is soft and pliable, and it is stated that ice will not stick to it.

Tents can either be purchased outright or rented. If they are to be used only a few weeks or months it is much cheaper to

rent them, but for longer use it is more economical to buy. Most of the larger manufacturers have in stock a large number of tents that have been rented for short time use, which can be bought much cheaper than new tents, and for many purposes they are just as good. A reliable maker will tell you truthfully just how long a second-hand tent has been used, and as he gives the weight of the canvas in his price list, it is not necessary to see the tents before purchasing.

Great care must be exercised in heating tents on account of the danger of fire. A fire once started is very difficult to put out. The tent is nearly always entirely destroyed. Where stovepipes run through the canvas, it should be protected with a drum made of tin or sheet iron. At least a sheet of tin should be used. It is bad practice to run the stovepipe out through the top of the tent. The proper place is through the end. This requires that elbows be used on the stovepipe. With this arrangement not so much heat will go to waste, as the stovepipe itself will assist in heating the tent.

### *Kinds of Tents.*

There is much that can be said regarding the selection of tents for use in construction work. Light weight canvas is the most costly in the end. The 12 and 15-oz. ducks are to be preferred for the smaller tents, and even for the larger tents, unless they are to be moved often, when the extra weight is a big consideration and hard wear comes from frequent handling. The increased cost of a 15-oz. duck tent over one made of 12-oz. material, in large tents, is about 20 per cent. The canvas should be double sewed with what is known as tent twine. All of the larger tents should be roped at frequent intervals along the seams, and the guy ropes should be well attached. Where ropes are attached, and poles go through the canvas, and at corners and other places, the canvas should be well reinforced. Machine sewing makes a good tent, but hand work makes a better one, so even at an additional cost hand work is to be preferred. The grommets or eyelets should be well protected, and the canvas should be reinforced around them. A very severe strain, especially in large tents, comes on the rings through which the tent poles pass. A very ingenious and useful article in this connection is the tent pole holder, which may be had from tent manufacturers. It allows the stay ropes to be at-

tached easily, and does away with the leather or canvas covered loops, thus preventing the canvas from being torn in windstorms or in erecting or taking down the tent. Small tents are seldom roped, but ropes add materially to the strength of any tent.

There are many different shapes and styles of tents. One of the simplest among the small ones is the Biddle patent tent. It is generally made 7x7, or 6x8 feet. The tent has no inside poles, but has two folding shear poles. It has a canvas floor, and the bottom edge is turned up inside to prevent snakes from crawling in. Only six pegs are needed. The tent is pyramidal in shape. Bedding can be wrapped up in it when moving, doing away with a tarpaulin for that purpose. This tent is meant for those sleeping in the open, and is easily set up and transported.

The "A," or wedge tent has a ridge pole, and is made for one or two people. A miner's tent is a square pyramidal tent with an inside center pole, while a pyramid tent is similar to the miner's tent, except that it has walls 2½ feet high. There are two kinds of Sibley tents. These tents are round and have a center pole like a pyramid tent. One has walls 2½ feet high and the other is without walls. All of these tents except the two with walls are without guy ropes, but are pegged directly to the ground. The Sibley tents are used by soldiers, but the author has used them in construction camps, and cannot recommend them, except that the top is so steep that it readily sheds water, allowing light duck to be used.

The Montana tent is triangular, with a wall on one side only. It has guy ropes on the wall side, and three guys from the top of the pole. The lumbermen's tent is, as a rule, 7 feet high in front, and runs down to nothing in the rear. The front can be raised to form an awning. Such tents are seldom used by contractors, but they would be very useful for temporary shops, the storage of tools and similar purposes. A very comfortable tent for one or two men is the Amazon tent. It is high in front with a 3-foot wall in the rear, being rectangular in shape. In the front it has an awning.

The tent most commonly used by contractors is a rectangular tent with side walls from 3 to 5 feet high, with a center ridge pole, and a gabled end and top. It is known as a contractor's wall tent. These tents are made in various sizes, and are easily pitched. They can be used for many purposes. A tent of this kind, 9 or 9½ feet

by 12 or 14 feet, can be used for four men. What is known as a family compartment tent is well adapted to contractors' uses. This can be divided into separate sleeping rooms, giving from 2 to 4 private bedrooms, and leaving in the center a common living compartment. These tents have walls at least 6 feet high, and have a hip roof.

Concession tents for use at fairs, make good commissary tents. The walls, 6 or 7 feet high, are made attached or detached, as desired, and arranged so that each side and each end can be rolled up separately or used as an awning extension. Thus an open store, which no one can enter, is made, with a protection for customers to stand under during inclement weather.

A long rectangular canopy makes an excellent dining room tent for a contractor's camp. During warm weather it makes a neat and comfortable mess room, and when cold weather comes sides can be placed under the canopy. These canopies can also be used by contractors for many other purposes, such as protection for stone cutting and other kinds of work, protection for machinery and tools and for newly constructed concrete work. A canopy of this type is the Wildwest.

One of the best tents for a large commissary is what is termed a round-end front and a gable-end back tent. This tent can be had in any size with high walls, and can be fixed so that entry to it is not easily obtained. A counter is built at the round end, and thus room is given for the men to enter to buy. The gable end allows goods to be stored without loss of room.

Large round-end tents, similar to those used by a circus, make excellent sleeping tents for a large number of men, and no space is lost in them. The men sleep in rows, with wide aisles left for walking and dressing. Such tents are valuable to contractors, even when they have large camps built of wooden shacks. When a large number of men are needed for a short time for special purposes or to hurry the completion of a job, the men can be accommodated in them on short notice. Such tents also provide a good mess room for a large crowd of men. The author once had to take care of about 600 men on a job that lasted only three or four days, and did it by renting several tents of this description.

For cooking purposes a small high wall tent should be used. The sides can be raised for ventilation.

### *Tents for Stables.*

An excellent way of housing horses on construction work is with tents. For circuses large round-end tents are used, so that the wagons can be placed in the center of the tent and the hay and feed can be taken care of in the same manner. However, the author prefers the ordinary stable tent used by contractors. The feed can be stored in one end, or better still, if large quantities are kept on hand, in a separate tent. The ordinary stable tent has sides, but there is also made what is known as a stable tent top. This is without sides. Except in very cold climates this is to be preferred. It is kept clean more easily, and the horses can readily be protected from the weather, especially if the width of the tent is never less than 30 feet. The horses are put in the tent in two rows, facing each other, and the feed racks are placed between them. A passageway for the horses is thus left on each side. A wide rack is built along each side of the tent to keep the harness on. The manure from the horses is thrown under this rack. Thus the manure accumulates and the heat from it keeps the harness in good condition in cold weather, and helps to protect the horses. Canvas can be put on the two ends. For feeding racks and troughs timber can be used, but canvas troughs can be bought from the tent makers. The canvas ones are to be preferred if they have to be moved much. Canvas feeding bags to be used on the work at the noon feeding hour can also be obtained from the manufacturers of tents. In arid sections of the country horses can be kept without a tent. It is only necessary to use a wind break of canvas, a strip 4 or 5 feet high, to form the corral so as to prevent horses from breaking away. This is cheaper than a tent.

### *Arranging and Caring for Tents.*

Tents rot out quickest on the sides where they touch the ground. To prevent dirt from blowing under the sides, it is generally well to bank a little dirt around the bottom, but this is a source of injury to the canvas. Every tent should have a ditch dug around it so as to carry off the surface water and prevent it from running into the tent.

Tent stakes for guy ropes should be set at a slight angle, and well driven into the ground. The guy ropes should be kept taut

to prevent heavy winds from blowing the tent down. When rains occur the guy ropes must be loosened or they will shrink and pull the stakes out, causing the tent to fall. On large tents the guy ropes for the poles should have a small set of blocks on them to draw them tight. For smaller tents a set of blocks and tackle should be used to tighten all the long guy ropes. Stakes for small tents are easily driven and pulled, but for large tents they are hard to pull, and are often broken in knocking them out with mauls. They can be pulled quickly and without injury by a stake puller, obtainable from tent makers.

Tents can have either a canvas floor or a wooden one. In many cases a dirt floor is used. For constant use the most satisfactory is a board floor. To protect the bottom of the side walls from rotting, a frame work can be built on a board floor, for small tents, and the tent placed over this frame work. This does away with the guy ropes also. By using several boards on the sides of the framework, a short wall tent can be made into a high wall. A door can be placed in the framework and a most comfortable place can be made in this manner. Tents used in this way will last for a number of years.

There are tents fitted with a framework covered with netting. The screens in the framework are made in panels of light, dry lumber. The panels are so arranged as to make a system of interchangeable units, thus doing away with the necessity of marking and numbering the parts. Anyone can assemble them and take them apart. The sides can be raised, and the front and rear can be made into awnings. These tents make very comfortable quarters.

Flies should be used whenever possible. They protect the tent itself from the weather, making it cooler in summer and warmer in winter. Money spent for flies is well invested.

In moving tents they should be rolled up or folded, and placed in canvas bags. This makes them easy to handle and prevents them from being injured.

*Erecting Tents.*

Anyone can readily learn to raise a tent, but to assist those who have never done this work the writer gives the following instructions, furnished by Mr. Geo. H. Dail of Columbus, Ohio:

"To erect a large wall tent, spread it out flat, place the ridge

pole in position, and push the center poles in place with the iron pins projecting through the grommets. Then drive the stakes for one side of the tent, and next push the center poles as nearly perpendicular as possible. Draw out the guys on the opposite side, and stake down, then straighten up the center poles. This is an easy method, particularly where the size of the tent is unknown. This applies to any well tent, or tents with ridge poles.

"To raise a stable tent, lay it out flat and place all guy ropes in position. Drive stakes and fasten guys loose. Then set the corner poles and follow with the intermediate. Fasten the main guys on both ends loosely. Then erect the center poles and place tackle on main guy, and tighten the ridge rope. Then guy the outside and corner guys. The ridge should be taut before any strain is put on the rim ropes.

"To set a hip-roof tent, lay it out flat, and drive all stakes. Set corners and other wall poles, then tighten up all guys, taking care that the rim pole is taut, and is in line, not bowed out. Then set the center poles."

These instructions are for rough and ready work. When tents are moved daily or weekly, the proper plan is to make a plat showing distances between stakes, and drive them before laying out the canvas. For large circus tents, the manufacturer generally furnishes a layout showing position of stakes and poles.

One of the manufacturers furnishes the following for putting up round-end, oblong tents: "Spread the tent out flat on the ground, with all guys in line with seams. Place the poles on top of the tent with bottom end in holes for same. Fasten hook of double block in ring on top of pole, and tie a string across hook to prevent it from lifting out in a wind. Take hook in single block and fasten to ring in tent, also putting a string across this hook. Put end of tackle (rope) through hole in tent so as to get hold of it from the other side, and when center pole is up, pull tent upon poles about 3 feet. Take the guys with loops and fasten over top of pole (loop end). Tie other end to stake, placed 12 feet from tent, and in position to form a brace. Then raise the poles, making guys firm and poles straight. Then put in stakes for tent's guys 6 or 8 inches less than length of side poles out from tent. When the stakes are all in, tie guys to stakes with a slack-in rope of 30 inches. Then put in all side poles, bottom first. Put spikes through rings when guys are fastened. When all are in, raise

the side poles. See that guys are tight to prevent tent from swinging, or cross two guys on each side until tent is up. Then place it back on its proper stake. When all poles are up, go in under the tent and pull up the tent with tackle, and fasten it well. The walls are in two pieces, and can be hooked on. Start where a door is wanted and go entirely around the tent."

### *Camps for Small Jobs.*

Tents and cheap shacks are for camps that are needed for a few months or for a year or two. Naturally, the longer a camp is to be used, the better it can be fitted up and the more comfortable it can be made. When the job is of such a character as to need power, as compressed air or electricity, electric light can be installed for a camp. It is also sometimes necessary to pump water for a camp or to install a small water system.

Unless a job lasts only a few months it is seldom necessary to charge any of the cost of the camp against the job, as the camp will pay for itself by rentals if it is managed properly.

### *Camps for Long Jobs.*

There are some jobs that are very extensive, the work continuing over a long term of years. The new Croton dam, built for the city of New York, was under construction for more than twelve years. The contract time for the Ashokan dam for New York City, now building, is seven years. Under such conditions it is possible to build a camp on a different plan from those already described, and on a more elaborate scale. The camp for the Ashokan dam is not only a large one, housing more than three thousand people (including employees' wives and children), but it is well planned and built.

### *The Ashokan Dam Camp.*

For these reasons a short description is given of this camp. The main camp is built on a hillside and is thus well drained. The camp is built somewhat on the order of a country town, having a number of streets laid off and named after city officials and officials of the Board of Water Supply of New York City. The

contractor's railroad runs through the camp, and has proper street crossings protected by sign boards. When trains move through camp a watchman or flagman guards the crossings.

The streets are lighted with electric lights, and during dry weather in the summer time the streets are kept sprinkled. On top of the hill on which the camp is situated, a reservoir has been built to supply the camp with water. Thus the houses are supplied with water, and a system of fire plugs is maintained. These with an organized fire department protect the camp from danger of destruction by fire. Alarms are turned in by a fire alarm system and by telephone, the general alarm being sounded by a bell on the engine house and by blasts of the whistle at the air compressor plant. A hose carriage equipped with fire fighting tools is all that is needed, as the pressure from the reservoir saves the use of a fire engine.

A small police department is also maintained. The officers prevent the bringing of liquor into the camp, and also prevent rowdyism. A justice of the peace has an office in the camp.

There are three churches in the camp. As many of the employees have their families with them, arrangements were made for schools to accommodate them. There are three or four buildings with an adequate corps of teachers.

There is also a kindergarten and a school for teaching the English language to foreign laborers.

A bank, capitalized at $25,000, is operated for the benefit of the employees, and the paymaster for the contractor maintains his office at the bank.

A fair-sized hospital and a nurses' cottage are maintained. The hospital contains one ward with ten beds, another with eight beds, two with two beds, and one private room. An ambulance is kept in connection with the hospital. In the two buildings are sun parlors, kitchen, laundry, dining room and sleeping rooms. The staff consists of a doctor and an assistant, a nurse and two assistants, an orderly, a maid, and a cook and laundress.

The office building is a two-story structure furnishing offices for the executive officers, the engineering and mechanical department, and the accounting and time keeping forces. On the top floor photographic and blue printing work is done. For the commissary department there is a large store building, a bakery, and ice and cold storage houses. The store is divided into two depart-

ments; one having dry goods and notions, clothing, shoes, etc., and the other groceries, meats, vegetables, tobacco, cigars and similar things. The bakery supplies bread, pies and cakes. Three delivery wagons are operated for the store. An ice wagon makes two daily trips over the work, supplying ice during the entire summer season.

In the basement of the store are kept potatoes and vegetables, and the second story of the building is used as a warehouse for the goods bought for the store.

A large boarding house, with a kitchen and a mess hall seating about two hundred people, is operated. There is also a private dining room in this building, and a large refrigerator. There are seven sleeping buildings, 30x90 feet and porches. Each is divided into sleeping rooms, and has a large reading and smoking room, wash room, bath, toilet, etc. There are also a number of 3, 4, 5 and 6 room dwellings for families. See Fig. 6. All of these buildings are built of boards and scantlings and are ceiled on the inside with tongue and groove pine or hemlock. The outsides are covered with Amazon or Pavoid roofing. The buildings are heated by steam or stoves.

The special buildings are of various types and construction and are built on masonry foundations.

Most of the buildings have a front and rear porch. See Fig. 7. The rentals charged include the water, fuel and all conveniences. The principal buildings in the camp after it was well organized were:

21 Standard 3-room dwellings of which 4 have baths.
21 Standard 4-room dwellings of which 5 have baths.
1 Standard 3-room dwelling for foreigners.
81 Standard 4-room dwellings for foreigners.
11 Standard 5-room dwellings for foreigners.
4 Standard 6-room dwellings for foreigners.
20 Standard 3-room dwellings for negroes.
4 Standard 4-room dwellings for negroes.
4 Barrack buildings for men, 4 rooms each.
4 Barrack buildings for men, 9 rooms each.
1 Special 3-room dwelling with bath.
7 Special 4-room dwellings with bath.
7 Special 5-room dwellings with bath.
7 Special 6-room dwellings with bath.
1 Special 7-room dwelling with bath.
Shoemaker's shop.
Barber shop.
Main office building.
Office building for engineers.
Store building.

Bakery.
Flour storage house.
Ice house.
Refrigerator house.
Kitchen and mess hall.
Dormitories.
Restaurant.
School houses
Hospital.
Nurses' cottage.
Fire department house.
Police station.
Bank building
Band stand.
Barn for saddle and driving horses.
Farm houses repaired for workmen

These are the buildings in the main camp. There are other smaller camps, some of which have portable houses as well as buildings similar to those in the main camp.

The sanitation of the camp is done in an excellent manner. By means of four and five miles of sewers, all the sewage is carried to a septic tank, from which it goes to the filter bed. It is then carried by pipes to the hill over Esopus Creek and is discharged down the hill over the ground to the creek. The sewers are flushed each morning. All garbage is collected each day and hauled away and burned. The houses are fumigated from time to time, and the whole camp is inspected by sanitary inspectors. Men are dismissed for infringement of sanitary rules.

A garden is provided with each house. Courts for various games, and an athletic field for base ball, foot ball and other games, are also provided. A paid band furnishes music from an open stand on special occasions. There is a pool room for the men, and a dance hall in which concerts and other entertainments are given.

*Camps at Panama.*

When the American Government first started to build the Panama Canal, poor arrangements were made for housing, feeding, and caring for the men. It was soon discovered that this was a great mistake, and the proper accommodations were arranged for. Meantime the work of sanitation had been started and it was not long before the finest and greatest camps for constructive work that have ever been built, were scattered over the Isthmus. Ice making machinery was installed and refrigerator cars were put

in service on the Panama Railroad to distribute the food. Fire departments were organized, and an entire civil government was established.

Comfortable dwellings were built and completely screened. Hospitals were established for the sick and injured.

A great deal was done in welfare work for the men. Societies and lodges were organized for the men, and clubs and sewing circles for the women. Dances, entertainments, games and other diversions were arranged.

The sanitation work was done on an extensive scale over the entire Isthmus. Waterworks and sewer systems were built. Roads and streets were rebuilt and paved. Houses were cleaned and put in a sanitary condition. The deadly yellow fever mosquito was fought and exterminated. The filling in of the swamps and low ground with earth from the Culebra cut was an asset in this work. At first men died of fevers and other tropical diseases; but this dangerous feature of the work was entirely eliminated.

*Sanitation for Camps.*

This indicates the importance of sanitation in camps. It is not always possible to do this in an elaborate scale, but attention has already been called to some features. A small stream running near or through the camp is a great convenience. Much trash and filth can thus be carried away; the water is convenient for washing out buildings when necessary; and the men can be made to bathe in the stream during the warm season. Lavatories should always be built, and the men should be compelled to use them. These should be cleaned from time to time and disinfectants should be used around them. If vermin get into the shacks the walls on the inside can be covered with poisoned whitewash. Bedding can be aired and kept clean. Provisions should be stored properly and the preparation of food should be done under sanitary conditions. Kitchen utensils should be kept clean. The camp ground should be kept in a sanitary condition. Pools of water should not be allowed to collect. Garbage should be hauled away. Rats should be killed off.

On the water supply work for New York City a state law requires certain precautions to be taken, and rules for sanitation are strictly enforced. A wire fence is built around the camp, its

top being so constructed that the men cannot readily climb over it. A ditch is also dug around the camp, and the surface water is run to a pool from which it passes through filters. Care is also used in providing the men good drinking water. Every precaution is taken to prevent an outbreak of contagious diseases.

### *Hospitals for Camps.*

Even in small camps provision must be made for the sick and injured. On long or extensive jobs, a good hospital can be built and maintained; but in most cases it is cheaper and more satisfactory to arrange with some local hospital to take care of the contractor's sick and injured. In unsettled sections of the country this can not be done. On short jobs, the author's method has been to build one shack off some distance from the camp, and, when necessary, to use this shack as a hospital. In this way contagious diseases can be isolated and treated. Smallpox and such diseases have thus been treated without spreading among the workmen. In some climates a tent can be used as a hospital.

### *Shops for Camps.*

Even on small jobs a shop is needed. In most cases a well equipped blacksmith shop for iron and woodwork is sufficient, but on long jobs a small machine shop is necessary. Spare parts of machines and castings are bought and kept in hand, but much special work must be done to repair machines and tools properly and promptly. For this, drills, lathes, power hammers, punches and such things are needed. Large and well equipped machine shops, and even a foundry, have been built at Panama. As a rule, a foundry is not needed in a construction camp.

### *Plans of Camps.*

Every camp should be planned to suit the locality in which it is to be situated, and to suit the needs of the work to be done. Some features of this have already been discussed in this chapter. As an aid to those who wish to give this subject some study, the plans of several camps are given. Figure 8 shows a camp laid out for some new railroad work, about two miles of the line being built

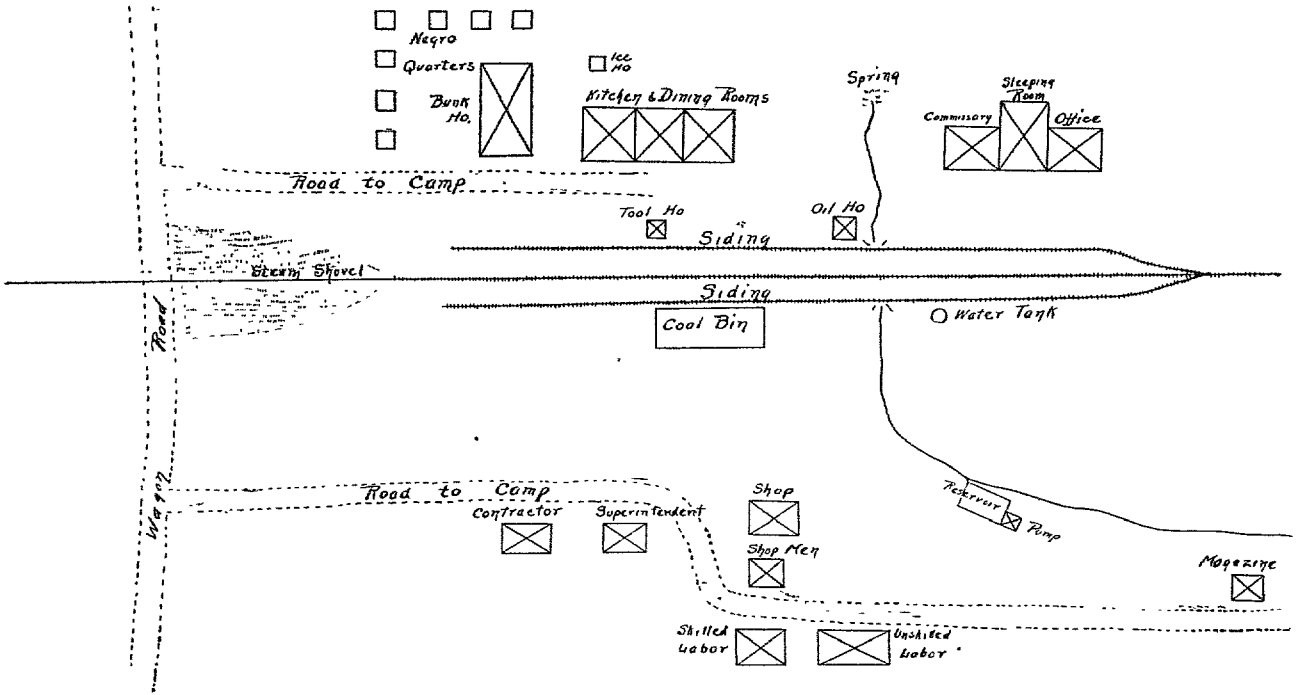


Fig. 10.—Camp for Steam Shovel Work on Grade Revision.

from this camp. More than a hundred and fifty men could be cared for at this camp. It was well arranged and was a very comfortable camp. It was used for a little more than a year. Situated on a hillside, the drainage was excellent.

Figure 9 shows a small camp built in the mountains close to a river. Stable room was not provided, as all teams were hired. About sixty men lived in this camp. As a good deal of trouble occurred with the mountaineers, the camp was well lighted at night.

Figure 10 is the plan of a camp built for grade revision work on the line of an operating railroad. It was convenient to the work and housed crews for night and day. The camp occupied a small space, yet housed about one hundred and twenty-five men. Some hauling was done to it by wagons, but most of the heavy hauling was done by train. Coal was burnt in the camp. On this job of more than half a million dollars' worth of excavation, several such camps were built, when cars were purchased for this purpose and the camp was then moved from place to place at small cost.

# CHAPTER VIII.

## THE MANAGEMENT OF CONTRACTS.

IT IS often stated that a natural leader of men makes a successful contractor, and certain ability along this line is no doubt an asset to a contractor; others who are without any marked ability of this kind have likewise succeeded. Napoleon was a natural born leader of men and possessed inherent military genius, but his military training from youth up made him one of the greatest soldiers the world has ever seen, ranking with Alexander, Hannibal and Cæsar.

### *Training Managers.*

In considering the phases of a man's characteristics we must reckon with a man's inborn ability, for some uneducated men, without any previous training in business, have achieved great success as contractors, just as the Confederate General Forest showed that he was a natural born soldier, whose achievements startled the world. Such men, however, are as rare in business life as in the military field. A large percentage of the successful men owe their advancement to the training they have received.

As engineering contracting is not yet taught in our colleges, the young man wishing to learn the business must go into the practical school of contracting, that is, the employ of a contractor, and learn the management of contracts in this manner. Each man must build up his own experience, learning little from the experience of others, and it is only after some years of work that he is able to cull out the good from the bad, and profit by his experience.

The author believes that a young man can learn much from books written by practical men on this subject and that the older man can be warned against mistakes made by others and that the attention of all can be called to the manner in which others have achieved success. If this little book will be of assistance in this line and thus help to place contracting on a more secure basis, the author's labor will not be in vain.

*Permanent Organization.*

As soon as a contractor obtains a new job, he begins to organize his forces to do the work. This is a common expression among construction men, and a contractor's forces are spoken of as "his organization." This is a good expression, but after a man has once started in business it should not be necessary to organize his forces. They should always be organized, and it should only be necessary to increase this organization for a job, and to curtail it somewhat as a job is finished. When a country goes to war it is not necessary to organize an army. Instead, the forces are mobilized and increased. So it should be with every contractor. His organization should always be intact. The process of organization is always expensive.

When a new job starts, the man in charge has his hands full. Not only has he to devise the plans for the work, see many salesmen, make many purchases, and interview numerous applicants for positions. Many men make mistakes at this stage in the manner of handling applicants for positions. Some contractors and managers do not seem to be able to tell just what new men will be needed, and they keep men in suspense whom they may never employ, putting their own company in bad repute among workmen, as well as doing the applicant an injustice. When employing a foreman or a man for some other position, in lieu of paying the salary demanded, some managers offer a smaller salary and lead him to believe that a better position will be given him shortly, with increased pay, when there is no such intention. This "jollying" seems to be a prevalent feature in employing men, and it results in disorganization. When a new man is employed to be placed in charge of old employees, every one seems to be loth to tell the old employees that the new man is to be their boss. Thus the new man loses some of his authority unless he forcibly shows it, and the men are likely to become disgruntled, all of which could be avoided.

The proper way is to treat such matters without sentiment, is to have fixed salaries for each position, and when men are employed, "jollying promises" should not be made. When men are employed to be placed over old employees, proper notice should be given all concerned. One method of doing this is by posting bulletins and circular notices to all interested. This method is

ridiculed by some contractors as being too stilted, but no harm can be done by it, as all the railroad companies use it and find that it saves much trouble and prevents disorganization. The posting orders of all kinds is to be commended, as men soon learn to appreciate that these orders must be obeyed, and employees feel that the contractor is taking them somewhat into his confidence by advising them as to steps he is taking to make the business a success. On every piece of work there should be a bulletin board. Much time is also saved the office force, as men so advised need not stop at the office to ask questions.

### *Rules for Contracting.*

This brings us to the consideration of rules in carrying on contract work. Rules can be of two kinds. First, those for the guidance of employees as to their duties—what they will be allowed to do, and what they must not do. Second, those rules that are restricted to methods of carrying on the work. These rules are a great help to the men, and some contractors call them their "Field System." However, few contractors separate these two classes of rules. It is the author's opinion that this should be done.

Some contractors even object to having any written rules for carrying on their work, but they cannot put forth any argument that cannot be set aside, while there are many good reasons why such rules should be used. The railroad companies find such rules a great help, and all the large roads have a printed book of rules and regulations. The author has found such rules of real assistance in carrying on construction work.

It is a misnomer to call a set of rules for doing work a "system." System is an assemblage of things adjusted in regular order so as to produce a whole plan or scheme, which is almost impossible with a set of rules alone, although a field system for certain classes of work can be designed and set forth in written or printed form. This, however, is seldom done, so that the word "system" should not be used for a set of rules.

The best method is to have in one form the class of rules first mentioned, namely, those for the guidance of employees as to their duties. These are general and in no wise make public the methods used to obtain results in carrying on work. When a man is about to be employed, these rules can be shown to him, and if he is will-

ing to observe them, then hire him; but if he objects to any of them, it is not worth while to give him further consideration. Such a book of rules can be used for all men in responsible positions, and should clearly show work that must be done by these men. In it report forms can be shown, and how they must be filled out and when they must be made. By this much labor on the part of the office force can be saved.

The book of rules on the work can at first be general and meant for use on all the work done by the contractor. Then, as new rules are added and additional lines of work are covered, the book can first be divided into sections, then afterwards separate books of rules can be gotten out, each one covering a different kind of work. Earth and rock excavating can be in one book, concrete work in another, steel construction in a third, and so on over the entire construction field. When a set of rules has reached this stage, the man doing one class of work is not bothered by a lot of useless rules on another subject when referring to his book. In such a book it is possible to reproduce drawings of standards that have proved to be money savers. Small buildings to be erected, scaffolds, concrete forms, track layouts, derrick set-ups, and many other things can be illustrated both by line drawings and photographs.

*System in Contracting.*

Although rules, or a lot of rules, are not a system for doing work, they may be a basis for such a system. System in conducting any business is highly essential, and this is especially so of contracting. A strong organization without any system means that eventually the organization will disappear, for these two should go hand in hand. To better a system of doing work means to strengthen the organization. Not only should an entire job be run as a well thought-out system, but each operation and class of work should be systematized. The most perfect and highest type of system and organization means the elimination of the individual, even the individual who organized the system.

This must not be taken to mean that the individual is not to be considered, for any one who attempts to build up a system of doing work, or an organization, without considering the individual will surely come to grief. Neither must the man be made a mere machine. Not only does the man resent this idea, but, rightly, the

labor unions are opposed to it. Of course in the abstract a man should be a mere thinking machine, but if the process is carried too far he ceases to be a man and becomes an expensive machine. As a man he is capable of originating ideas, as a machine he is not.

The idea should be rather to do away with the individual as a director of the organization. Barnum, the great showman, who built up a wonderful circus organization on a most exacting system, realized this, as he stated a few years before his death that he had his show running on such a system that if the organization was not changed the show would go on indefinitely after his death. Although Barnum has been dead more than ten years, his circus is still known the world over. Thus it is shown that the individual can be eliminated, even the one who organized the system, and at the same time the importance of a definite system is illustrated.

Within the past ten years there has been an awakened interest among contractors as to improving their methods of doing work and the system under which they have carried on their jobs. One thing that has caused contractors to consider these subjects more closely has been cost records and the collection of cost data. An analysis of detail cost records and a comparison of records kept on similar work done by different methods enables one to select the best and cheapest method, and then from the results so obtained, to improve upon the system previously in use. This is the great need of cost records, and for this purpose they cannot be kept in too much detail.

*Scientific Management.*

It is because of this bettering of systems through improved methods of doing work and the keeping of costs that attention has been called to scientific management and efficiency engineering. There is a great field for such work among contractors. Although many contractors have through their own engineers and managers done much in this line, yet their time is so taken up with the great details of handling the work and completing the contract on time, that they seldom have the time to eliminate the ordinary waste of materials and labor. In some cases these wastes are seen and recognized as such, but in most cases, bound by training along certain methods, the ordinary man in charge of work either cannot see or will not see these things.

Results can easily be obtained by economists when the same

acts are continually repeated by a large number of people, and those doing the same work can be grouped together, as this might be termed the "a b c" of efficiency engineering; but the great results are obtained in many lines of business when the conditions are exactly the opposite of this. In other words, efficiency engineering is a broad subject. It includes the culling out of obsolete business ideas, the substitution of contract work for day labor, the paying of bonuses, the discarding of unprofitable parts of a business, the elimination of both waste of materials and labor, the selection of plant and machines, arrangement of plant and men, the operation of machines, the handling of tools, and a hundred other details.

The work of the past and the results obtained have been mostly in the mechanical branch of engineering or commercial manufacturing. But some of the great reforms and results obtained have been in teaching men to use judgment by paying them extra when they gave thought and study to their work, thereby increasing the amount of work done and the quality of it.

The work of the future will be in the field and under conditions that are seemingly against the efficiency engineer. This includes the engineering-contracting field in the work of rearing engineering structures, where the same man does not perform the same work twice, the operations are conducted at widely scattered places, the workmen are incompetent, the plant inadequate, the designing department poor, and possibly the bank account exhausted. Without a business and with a depleted bank account, an economist cannot create a business nor can he perform wonders or miracles. But with the other conditions he can work, and if he himself is competent, obtain astonishing results.

If a business is not profitable, in nearly every case it will be due to a different cause, so that the first work is to locate the great waste and eliminate it. This in many cases may give some profit to the work. In one case the economist found that a paper mill was manufacturing two grades of paper, each grade being sold on a contract. One grade was made at a slight profit, the other at a loss. He at once went out in the market, and by contract with another mill obtained the paper necessary to fill the losing contract at a small profit. Thus the first great waste was cut out and the business was made profitable at once, and then by additional studies and thought the profits were further increased.

In another case a contract for a filter plant was changed from a losing to a profitable one by substituting three machines of greater efficiency for eighteen machines of another type, saving thousands of dollars in labor and fuel.

In handling scraper work, the cost was high, owing to hired teams and drivers going at a slow pace and insisting on following one another closely. Teams changed frequently, a foreman having some different teams each day. An efficiency engineer showed the contractor another method of loading so that each scraper carried a larger load and the teams were spaced better—in spite of the effort of the teamsters to do the least amount of work possible—thus reducing the cost of the work several cents per cubic yard.

In pick and shovel work, even where men change daily, it is possible to accomplish astonishing results by scientific management. The author, upon one occasion, found that a difference of two mills in the cost of picking called for a rearrangement of the men so that the next day's work showed a decrease in the cost of excavating of nearly two and a half cents per cubic yard.

In erecting timber trestles, the author on one job so systematized the work and improved upon the method of erecting as to save a little more than a dollar a thousand feet board measure on the cost of framing and erecting.

On pile driving work similar results have been obtained and men working on machines have learned that even axle grease must be accounted for, and without undue waste a 50-pound bucket will last a month.

Hauling of material in cities, and even over rough mountainous roads, can be systematized and the efficiency of the work often improved a hundredfold.

Many other examples could be adduced to prove the value of system.

There is danger that each man is liable to think that the very waste occurring on another man's job does not occur on his, and in many cases he also believes that he knows more about his work and how to conduct it than anyone who might be employed by him. It is in these very things that he errs.

As soon as a man feels this way, he can rest assured that he needs the services of an efficiency engineer. Some years ago the author had one of his assistants to keep a detail record of how the time of a contractor's forces were spent. This record showed gross

incompetence, and that the men were loafing nearly half of their time. When this record was read to the contractor, he not being told it was on his job, laughed at the results shown, and said that with his excellent system and organization such things could not occur on his work. Such men are the easiest fooled, and workmen soon learn such things.

An efficiency engineer or construction economist can go upon a contractor's work and materially improve its efficiency. Such a man has no one's interest to serve except his employer's, and unless he can show decided results he knows that his employment will not be continued. Thus he is compelled to make good. He is there for one purpose, and unlike other men in authority whose duties are many, he is able quickly to obtain results. A dollar invested in this manner with a competent man means the making of additional profits.

We are but at the threshold of efficiency engineering, and no man can tell what its limitations will be. Men have dreamed strange dreams that have come true and revolutionized the business of the world. Morse was considered a dreamer and his telegraph instrument a mere toy. But it revolutionized the world and increased the efficiency of the world's business.

### *Standard Plans.*

The standardization of methods and work always trends toward economy. This result can be partially obtained by rules and by standard plans for all structures. Even in building a camp much money can be wasted. Each man will have a different idea of the size and shape of the various buildings needed, and in but few cases will any consideration be given to the economies of the subject; how the lumber can be best worked up without waste, how framing and nails can be saved, and many other things of this nature. With standard plans, and the necessary information furnished on them, much money will be saved. As with this, so it is with everything.

### *Colors for Contractors.*

Tools and machines must be given constant care, and should be marked in some manner so as to be quickly recognized in case they are stolen. One of the best ways of doing this is by painting

all tools and machines certain colors. Thus one contractor uses a grey color, another blue and black, some red and so on through a long list. This further aids as an advertisement, as contractors doing much work in one locality or city are soon known to the public by the colors used on their equipment. Even small tools can be painted in this way, the head of the tool, such as a pick or hammer, being painted one color, and half the handle the other color. The paint not only improves the looks of the outfit, but it serves to protect the tools and machinery from the weather. Painted each year during the off season, the outfit will always present a neat appearance.

Another method of marking tools is by branding them. Both wood and metal brands should be used; but one must be close to the tool to make out the brand, which is a disadvantage. As the paint will wear off, while the brand will not, it has this decided advantage.

*Care of Tools.*

All small tools should be kept in boxes built for the purpose and some one should be made responsible for them. A record should be kept of all tools and machines, as well as supplies on hand. These must be frequently checked and if any tools cannot be found the man responsible should be required to pay for them. On the inside of the lid of the tool box a list should be kept of the contents of the box. If the man in charge of the box cannot produce a tool called for he must either show an order for borrowing it, or a part of the tool if broken. In addition to tool boxes there should also be a tool house where new and extra tools can be kept, together with ropes, blocks, pumps, and similar outfit that is not used every day.

Much money can be wasted by losing tools or having them stolen. This last item, on a job in the country, is not a small one. Men drop small tools on the ground where they were last used, and farmers finding these, consider them as having been lost and in many cases carry them to their homes. This can be prevented by a proper system of caring for tools. Every tool on a job should be checked at least once a week. It is not necessary to employ an extra man for this work; for a timekeeper, storekeeper, or other clerk can do some of it each day.

A workman should never be allowed to bring a tool of his own

on a contractor's job. It is the custom in some sections for a common laborer to furnish his pick and shovel. This may mean a saving on a small job, where only picks and shovels are used, but on a fair sized job, where many kinds of small tools must be used, to allow men to have their own tools means that many tools will be stolen by the men and sold for drink, the claim being made that the tools belong to them. Often when a man is discharged he will carry away a number of hammers, wrenches and other tools saying he brought them onto the job with him. The only way of preventing abuses of this kind is to prohibit any workman from furnishing tools. Another disadvantage of men furnishing their own tools is that they will work with a wornout or partly broken tool, doing indifferent work for that reason.

Some contractors make it a rule to charge each workman with the tools he uses. Thus a man with a pick and shovel has each of these charged to him and the amount deducted from his pay. This makes a man take care of his tools. But it is an injustice to the man, for if he has to be changed from one class of work to another it would be wrong to make him purchase tools for each kind of work. Again, with such an arrangement the contractor can have no control over the tools being used on a job in case of emergency work when every available tool may have to be used.

### *Hauling Materials.*

No matter whether a contractor does his hauling directly with his own vehicles, or has it done by other contractors, he must pay for the wastes that occur. He, in turn, may make his employer pay for such wastes, but if the contractor can prevent these, the first money saved will go into his own pocket and it will not be saved for the owner of the work, that is, the contractor's employer, until the majority of contractors have been able to cut out this waste.

Contractors do two classes of hauling—that of hauling materials and supplies from the source of supply to the scene of their work, that of hauling excavation and similar things on the scene. The above remarks are applicable to both; but this discussion will be limited almost entirely to hauling materials and supplies to the work.

For some classes of construction the average of the haul

is definite. Thus the hauling can be calculated either on a unit basis or in the aggregate and the cost figured very closely before commencing the job. This is so for buildings or any class of construction that is limited to a small area. But for work over a large area or along great distances, as on railroads, canals and power transmission lines, the hauling of materials will be at best a very uncertain quantity. Teams today are at a premium, and when hired are worth a cent a minute. In some sections this cost is slightly less, but in others, as in New York City, the cost exceeds this, running for a two-horse team as high as a cent and a half per minute. It is thus seen that any waste team time quickly runs into money, and that if the length of haul is increased, as is sometimes the case, the extra cost is not a small item.

Even when the hauling is let out by contract, these things all affect the cost, for the hauling contractor must consider them and charge accordingly. He might not charge for all these things the first time, but he is not likely to be caught napping for a second time.

In the past, contractors have done their hauling of supplies and materials almost entirely by horses or mules. Occasionally oxen or some other quadrupeds have been used, but it has all been by animal power. Consequently, this has been the basis of the cost of that work.

At the present time, contractors are learning that mechanical power can be used, and the cost is considerably reduced. Thus traction engines are beginning to play an important part in the contractor's work. At first they were used to propel such machines as elevating graders, while excavating. This called attention to the work they could do, and they were tried at hauling materials on long hauls in the country. They proved economical even with the ordinary wagons.

Then the manufacturers turned their attention to improving the wagons, so that today we have numerous kinds of steam wagons or cars. These are made much more strongly than the ordinary wagon and they are built to carry much heavier loads. The carrying capacity averages from five to fifteen tons. The cars are built as both bottom and side dumps, and large flat cars can be bought to haul heavy machinery and long timber, I-beams, columns and such things. These wagons are coupled together in trains, and the loads carried vary according to the horse power of the engines;

but as much as from twenty-five to thirty-five tons are hauled in a train, the limiting factor in many cases being the small loads that some wagon-road bridges can take.

The economy of this kind of hauling is evident. With horses, large loads can be carried. Many strong teams can be used, and three or four wagons can be coupled together, as is done in hauling in the Rocky Mountains, where often from twenty to twenty-five tons are carried by one train of wagons. But to do this, from twenty to twenty-four horses are used. Only two men are needed, as with a traction engine, but as the care, feed and interest of each horse is about one dollar per day, the daily charge is excessive. The cost of a traction engine, that compares with this, is the interest and depreciation charge and the cost of the ton of coal and the amount of water consumed each day for a 30-horse-power boiler.

We have at present another kind of power hauling adapted to a contractor's business. This is the gasoline engine. The gasoline tractor is simply a traction engine run by gasoline instead of steam. What has been written regarding the traction engine is applicable to gasoline tractors, except that those exploiting them state that the cost of operation is less.

A third power hauling vehicle is the automobile. These are electrical, steam or gasoline driven. They are given various names, the most common being "auto trucks" or "commercial trucks." So far, these have been confined to single hauling units, but they will no doubt be developed into trains, as is done with electrical motor cars when trailers are used.

When the auto truck was first used, its loads were limited to only a few tons, for it was not possible to get tires to stand up under the work with heavier loads; but better tires are being made. Five-ton trucks are now common, and many trucks are being operated that carry seven, eight, nine and even ten tons. Then, too, a few years ago, it was thought that it was only possible to operate these trucks over paved streets and roads; but this idea was erroneous, as they are now used on rough country roads, and it has been proven that the automobile can go over almost any kind of ground, even rough mountain trails.

These things have placed the auto trucks in the front for heavy hauling, and no doubt further improvements will be made in tires, making the cost of maintenance much less. Solid tires

are used on these trucks, and there is no reason why these solid tires could not be made in short sections, so that in case of accident or wear only a short section need be replaced.

The use of auto trucks in contracting is not a matter of conjecture; for they are actually being used by contractors. Even where horses are being used the auto truck is also employed, and it is only a question of a short time before contractors generally will replace many horses with automobiles or other machines.

Thus contractors have, under present conditions, a chance to effect a great saving in one of the most difficult and expensive features of their work. The hauling of materials and supplies has made many a contract unprofitable, and too close study and attention cannot be given it. It is estimated that the ordinary cost of hauling will be cut in half, and yet that a profit will be made on the work. This is possible; for in each trip twenty tons or more will be hauled instead of two or three tons.

As soon as contractors use these improved methods of hauling materials and supplies, it will mean that the same methods will be used for the hauling of excavation and similar materials on their work. There is little doubt that a traction engine with a train of two or three yard bottom dump cars can serve elevating graders, steam shovels and other excavators much more cheaply than single wagons with horses. Such trains will compete with the dinkey engine and train cars, especially in building reservoir embankments and other structures where materials have to be spread out in thin layers. Large four-wheeled scrapers in trains, with traction engines to load and haul them are now being used.

### *Paying for Hauling.*

The method of paying for haul on materials vary. In some cases, the price is included in the materials in place. In others, a flat price is paid for some unit such as a ton, and at times it is paid on a ton-mile basis.

Materials most frequently hauled are lumber, pipe, stone, cement, sand, iron, rails, structural steel, machinery and other heavy articles. These can all be hauled on the ton basis; but since timber is generally measured by the thousand feet board measure, that becomes the unit generally desirable for hauling.

*Over Haul on Materials.*

On some classes of work, it is the custom to make a price covering the haul on such materials as are called for, when the haul is a mile or less. This is known as the free haul. For all additional miles or a fraction of a mile, a stipulated price is paid for each ton. This is known as over-haul. This is a true unit basis payment, and can be commended as being fair and equitable to both parties of the contract.

When a contract does not contain an over-haul clause, as outlined, but includes the pay for the haul in the price of the work, a great injustice may be done the contractor inadvertantly. This may be brought about in several ways; for when over haul is not allowed the cost of hauling must be estimated for all the contemplated structures. When all plans are furnished before the contract is let and no changes are made, this is readily done; but, since it is seldom possible to present complete plans in advance, the cost of changes falls heavily on the contractor.

An example serves to illustrate. A contractor took a contract to build ten miles of railroad upon which there were several timber bridges to be built, using in the aggregate, half a million feet of timber. All of these bridges were located upon the first four sections of the line, that is, within four miles of the front of supply. Figuring upon these conditions, a proposal was made for timber to be furnished and erected in the bridges at a stipulated price per thousand feet board measure. Work was commenced on the road, and a few months afterwards it was found that on section eight and section ten two large embankments, which were to have been made from earth borrowed from the right of way, would have to be changed to timber bridges; for the property owners named prohibitive prices for land for borrow fits. As these two bridges called for nearly a million feet of timber, the contractor found his work suddenly increased and his haul on material changed from a very short one to a long one. Instead of his average haul being three miles, the basis of his estimate, it became seven miles and the amount of hauling increased two hundred per cent. Consequently, the cost of hauling became six times as much as he originally estimated, which more than consumed his profits. This would not have been the case if his price had only covered the cost of furnishing and erecting the timber and the contract had provided

for an over-haul price after the first mile. Then the owner would have paid for the work he had done, and the contractor would not have suffered a hardship.

This shows the need of a unit price for hauling. It should be added that the length of haul should be measured along the wagon road over which the material is hauled, or for railroad or canal work, along the center line. Then too, the number of pounds in a ton should be specified. Although the ordinary ton is considered 2,000 pounds, yet in some sections of the country and for some materials, the long ton of 2,240 pounds is used. To prevent disputes all details of payment should be stated in the specifications.

It is self evident that the cost of hauling is governed by the amount of load that is carried, and the size of the load is regulated by the steepest grade over which it is hauled. Keeping these facts in mind, and basing the cost on a ton-mile, a contractor's price for hauling can easily be estimated.

### *Foreman.*

In contract work, or in fact, in any class of construction or manufacturing, the foreman factor is an all important one. Thousands of men are thus employed, and the employer is entirely dependent upon the foreman for the handling of all details of his work. Their success means success for him; their failures and shortcomings mean money losses for them. Frequently we hear foremen and contractors say that although a profit has not been made upon a certain piece of work yet a loss has not been sustained.

The author has always asserted and maintained that if a profit has not been made by a contractor, a money loss has been sustained; for in the contracting business it is not possible to stand still. We must either go forward or else we take a step backwards. There may not be a direct loss on a job, but the indirect loss may soon show itself and be keenly felt. To illustrate: A railroad contractor with a twenty-team scraper outfit undertakes a contract to build a section of a road. At the end of a year's work, when he draws his final estimate and balances his books, he finds his profit and loss account is balanced and he congratulates himself upon the fact that although he has not made a profit yet he has not lost

money. But he has. His money is worth money and if interest has not been earned on the capital invested, that much has been lost. His time, too, is worth money and if a profit has not been made to recompense him for the time and thought put upon the job, he has lost money. During the year, the horses and mules and the scrapers and other tools have been exposed to all kinds of weather and worked to the utmost, so that they are not as fit to start a new job as they were before. In other words, they have depreciated in value. This is a money loss that soon makes itself manifest. Thus the contractor's time has gone for naught, and his capital has depreciated so that he has sustained serious losses.

A contractor must always be attentive to his duties, but his close attention means but little unless his foremen are alert and try to work for his best interests. Many foremen state that if they cannot make money on a job for a contractor they want to resign. This is as it should be, if it is the fault of the foreman, but if it is not, a foreman makes a grievous mistake by resigning when a job is not netting a profit. At times a contractor underestimates the work and takes a job at prices that are so low, that it is not possible to make a profit, and there are occasions when unforeseen conditions exist or accidents occur that turn a seemingly profitable contract into a losing one. There are circumstances over which a foreman has little control and if his labors do not show a profit he is not to blame, but on the other hand he should not desert the ship when disaster overtakes it, but rather put his shoulder to the wheel and by concerted action with his fellow foremen and with his employer, the contractor, pull the job through with the least possible loss. A foreman's reputation is not injured by being employed on a losing job, unless money is lost through his fault, and if he leaves the job at such a time, he will suffer in reputation and he will soon be known as a "quitter," a man who gives up as soon as he encounters difficulties. To continue work will help to make his reputation, but those interested will learn of the circumstances, even if he says nothing about the facts.

With easy work, good men, efficient tools and machinery, it should not be difficult for any foreman to make money for his employer, but with adverse conditions, when good men are discouraged, and with worthless laborers and a run down plant, a foreman who can then bring a job through to completion at the lowest possible cost shows that he is a man of marked ability. It is

only by overcoming difficulties that we learn, and on a job where there is only trouble and loss, a man has a greater opportunity to learn and make a reputation for himself than where things run smoothly. Bitter and costly experience is the most valuable to us. George Washington showed his great ability at Valley Forge rather than at Yorktown. Valley Forge made Yorktown possible.

Many examples in the contracting business can be cited to illustrate these things. Only recently a contractor was losing money on a heavy piece of construction work located in the east. He himself was ready to give up the job, when he succeeded in obtaining a superintendent or general foreman who was not afraid to be employed on a losing contract. This man reorganized the work, obtained for the contractor certain concessions from the owner, changed the methods of working and ended by turning a losing contract into a winning one. His reputation was materially enhanced so that when he stepped out of his position he went to another job where heavy losses were being sustained, and once more so improved conditions that a profit was made on the job. This man will never lack work; but what would have been the results if he had said, "I cannot afford to let my reputation suffer by working on a money losing job"?

A foreman should always be alert to learn and should welcome advice. No matter how long we have been following a particular line of work, there is always something to learn. At all times we should be willing to learn new methods and be ready to give them a fair trial. If they are not money-makers they will soon demonstrate the fact and can then be discarded. Even an artist can learn from a cobbler. Many foremen will take orders from their superintendent and employer as to what work to do, but they will not allow themselves to be advised or instructed as to methods of doing their work, acting as if those above them could not possibly know more than they do. Granting that this is the case, it is wrong in most cases not to follow the contractor's orders or advice, as it is his money at stake and not the foreman's, and it should certainly be the privilege of the contractor to decide how his money is to be spent, when he wishes to assume that responsibility.

There are times, though, when a foreman might be justified in ignoring orders or even in directly disobeying them. To illustrate: A foreman asked permission of a contractor to allow him to rent a well-drilling machine to drill blast holes for blasting in

front of a steam shovel and to make holes for deep blasts. This was before the days of using these machines for that class of work. The contractor absolutely refused to allow such a machine to be brought onto his job. The foreman did not argue the question, but as soon as his employer left, he went off and hired the well driller and put it to work. A week or so later, the contractor again visited the job and one of the first things he noticed was the well driller at work on a hill. He at once inquired who had hired the machine and when told it was the foreman, who had asked permission to do so, the contractor at once ordered him dismissed for disobedience. After being discharged, the foreman went to the contractor and told him that in many ways he had done the proper thing in discharging him, but at the same time he had proven he was right, for with the machine he had materially reduced the cost of drilling and had saved in a short time several thousand dollars. Upon investigation, the contractor found this was true and he at once reinstated the foreman and placed him in charge of all drilling. He also gave orders for the purchase of a number of these machines. A short time after this, one of the leading engineering journals published a description of the work done by the well drillers on this job, with the result that such machines have been employed on contract work in this country ever since. Here was a justifiable case of disobedience. A case showing that the foreman was a man of his convictions and willing to sacrifice himself to prove that he was right, and by doing this he gave the construction world an efficient tool.

### *Foreman's Wages.*

The cost of foremen to a contractor is a heavy item in his expense account. The smaller the job, the larger is the proportionate cost for a foreman. In earth and rock excavation, this expense may sometimes amount to several cents per cubic yard and may be no inconsiderable part of the total price the contractor may receive for his work. It lies entirely with the foreman to lessen this cost. Not by taking less wages, but by increasing the efficiency of his forces and of the machines that he has in charge.

The wages paid to a foreman should hardly be taken into consideration, provided he obtains results. To hire a foreman because he can be employed for a low wage is false economy. His ability

should be considered, and if he is found to be efficient and experienced he should be engaged.

Hiring foremen and deciding upon their wages is a most important subject. It is difficult to judge a man's ability as a foreman from his appearance and a short talk with him. Most of them are very apt in telling of the work they have done and of how they can manage men and obtain remarkable outputs from machines. Good foremen are always scarce, and when in need of one, if it is not possible to obtain a man who is recommended by some other contractor or engineer, or one who is known, it is necessary to employ a foreman who may apply for a job. He is an unknown quantity, and it is always a question as to what salary to pay him. A contractor is not looking, or rather should not be looking for a low priced man, but at the same time he does not want to pay a large salary to a man who may be inefficient and have to be discharged within a week or two. A good method in such cases is to employ a man, say at a daily wage of three dollars, and tell him that if he proves satisfactory within a month he will be paid the standard wages of four or five dollars per day. A man without a job cannot object to being employed in this manner, and the contractor protects himself somewhat by this method.

Some contractors pursue this course, and when they secure a good man soon place him on a monthly salary instead of a daily or weekly basis. This means that the man has regular employment even during bad weather, and that he receives a stipulated salary. When work has to be shut down or the contractor finishes all his jobs without obtaining new ones, the best of the monthly men are selected and left on the pay roll and given such work as overhauling outfit and repairing and painting tools and machinery.

Some contractors find that they can not only get the foremen to take greater interest in their work, but that the foreman obtains more work from his men and machines when he is paid a bonus for improved efficiency. These bonuses are paid for either weekly or monthly work.

In doing this, the writer's practice has been to keep a very detailed account of the cost of each foreman's work. All labor, teams, supplies and other expenses are charged against the foreman, together with the section or part of work of which he has charge. At the same time records are kept of the work he does. These daily records are checked against the engineer's estimates,

so that they can not be padded without detection. In this way, it is always possible to tell if a foreman is making money for his employer, and it is also the basis for a system of rewarding the foremen with a bonus. Then, if the foreman does not come up to a certain standard or show a profit on his work there is cause for discharge.

It is quite surprising to those who have never used this method, to find out that many so-called "good foremen" do not show a profit on the work they do each month. On one job of railroad work done by the author, he employed nine foremen, and in order to obtain efficient men he used this method. Three good foremen resigned their positions to take better ones during the job and to obtain the twelve men who proved satisfactory, seventy-seven different men were tried out. A few who showed a profit on their work were discharged for drunkenness.

Such a method keeps a foreman anxious to obtain results and there generally springs up a friendly rivalry between the different foremen doing the same class of work. They also study their men to learn what kind of work the man is best suited to do.

Some years ago the author had a number of foremen who each complained that one or two men in his gang were not doing good work and should be discharged. In every case the men had been employed for several years, many of them longer than the foremen. Laborers were scarce and it cost from $15 to $20 transportation to obtain new ones. The writer consequently decided to change his organization for a short time. He selected a foreman who quickly sized up men's ability and gave him the men with whom the other foremen were dissatisfied, to use in his gang, dividing his men among the other crews. This foreman worked these men for about three weeks and showed more profit from their work in that time than either he or any of the other foremen had ever made in a month. He was anxious to keep these men under him, but the other foremen seeing how their old men were handled and the results obtained, clamored to have them back. The old organized gangs were formed again, and every foreman got better results from that time on.

The test of a foreman showing a profit on his work each month is hard on most foremen. A contractor employed the author to increase the efficiency of his forces, and he quickly found out that many of the foremen whom the contractor believed to be his

best ones, really showed a loss on their work each month—or the profit was so small that they hardly covered the overhead charges. It was difficult to prove to the contractor that such was the case. One man who was considered an efficient blaster lost money each month on his blasting, due to ignorance of handling explosives.

General foremen or superintendents are employed in most cases on monthly salaries. However, many of them are paid a percentage of the profits made on the job in addition to their salary. This is a bonus to obtain better work from them, and it is generally successful. However, some contractors who do this will not consider paying a bonus to a foreman. If the method works well with the superintendent it will also improve the work of the foremen, and the author has gone farther than this, by applying it to the laborers themselves.

One great advantage in the last named case is to materially decrease the foreman cost. Men working to make a bonus can be worked in larger gangs, so that the foreman's wages are distributed over a greater amount of work, or by the bonus or task system a few men can be worked at a task, and a foreman's time divided among a number of such gangs, while by the ordinary method foremen must give close surveillance to each man.

The day for a foreman to swear at and beat his men is past. With some he may have to be emphatic, and at times harsh, others may be stirred to quicker and more work by praise. A foreman should study the temperament of each man under him, and handle him accordingly. No two men can be controlled in exactly the same manner. Words of praise are essential to both foremen and men. They are valued as highly by employees as the contractor values commendation from the engineer under whom he is working. Remember that a laborer is a man, and that since he is on a lower round of the ladder of life, he feels his position keenly and is quick to resent any slight or seeming hardship.

Great care and consideration should be given to placing foremen in charge of certain work; for frequently foremen are given work for which they are entirely unsuited. One man may be competent as a sub-foreman and yet be a failure in charge of the whole force, and a man may be successful in running a scraper force, when the teams are owned by the contractor, yet may prove a dismal failure with hired teams. These things are not really the

foreman's fault, but rather the contractor's, as the latter should be a quick judge of a man's qualifications and his disposition.

Many contractors make the mistake of making foremen of good active laborers, the so-called leaders of their gangs. They generally ruin a good laborer and make a poor foreman. The proper way in such cases is to encourage such men by increased pay, then to make them a sub-foreman, then assistants, and finally after this training, promote them to be a foreman. The chances are that they will be good ones, as leaders who rise from the ranks by hard work are as a rule competent.

There is no doubt a great field open to young, industrious men of the country to fit themselves for foremen on construction work. Contractors in all sections of the country are continually on the lookout for foremen of ability. They prefer young men to whom they can teach their methods. It is to be regretted that many people think the title of foreman a reproach. It is not. It is as honorable a position as that of clerk or manager. Young men should not hesitate for any such false notions. Their chance of promotion is great—greater even than that in the engineering field.

With less education than that needed for engineering, a young man can start as a foreman and rise higher and more quickly. From foreman he can go to superintendent, general manager and become a contractor if he wishes, better equipped for success than through any other channel. Should he possess an engineering education or training it will be an aid to him. The supply of able foremen falls short of the demand.

### *The General Question of Wages.*

The compensation paid men is always a matter of much concern to a contractor. The labor cost is the great uncertain factor of construction work. Naturally, no one wishes to pay more wages than he has to, but on the other hand, small wages breed discontent, and a man, no matter how ignorant he is, will hardly put forth his best effort for a small wage. Wages, however, sometimes go so low that men cannot support themselves and their families, and when these conditions become general and "starvation wages" are paid throughout a country, strikes and lockouts occur everywhere, and men and women become desperate and resort to violence.

In fact, some of the great upheavals of the world have been caused by low wages. The Wat Tyler rebellion was caused by low wages, and its effects has been felt in the English speaking world down through the centuries even to the present time. Labor unions date from the days of Wat Tyler. The railroad riots of 1877, when the author saw the militia shoot down strikers and their sympathizers, was a movement of this kind, and although it was seemingly unsuccessful, railroad men have been better paid since then.

Low wages are a comparative thing, depending on the purchasing power of a dollar. Thus, a man receiving a wage of $1.50 per day may obtain a better living from his earnings than when receiving $2.00 per day, as the cost of living may have increased fifty per cent and wages only one-third. The general tendency of wages during any long period of time is to increase, but the cost of living also increases. In later years, the cost of living has advanced not only because of the rise in prices of foodstuffs and clothing, but because real estate has increased in value, making rents higher. Then, too, our plane of living is much higher and improves in each decade. The working man of today lives on a higher plane than he did fifty years ago.

### *Capital vs. Labor.*

As a result of all this, fair wages must be paid for all work, from the man in charge of a job to the water boy. The doctrine is being preached throughout the land that the laboring man, the man who toils with his hands and earns his daily bread by the sweat of his brow, is the only creator of wealth, and that his interests are directly opposite to the man who furnishes the capital or the brains for any enterprise or undertaking. Nothing could be further from the truth. It is true that the laboring man is a creator of wealth, but so is the man with brains and likewise the capitalist. The interest of the three may vary somewhat according to circumstances, but in the end they are identical, and each one is necessary to the others.

The North American Indians dwelt in a rich country and labored in raising corn and a few other things, and in following the chase, yet they amassed nothing and lived as simple savages, owing to the lack of capital to direct their labor and provide a

market for them; while in Mexico, Peru and other parts of the western hemisphere, mines were worked, fortunes were amassed and a capital class directed the labors of the workmen, so that cities were built and the people of those countries enjoyed a high state of civilization in comparison with the Indians. No matter what conditions exist, labor produces but little unless directed by capital. The farmer working alone upon his own land is directed by capital, for he is stimulated to produce crops and send them to markets created by capital.

Capital, on the other hand, can do nothing without labor. The miser with his hoard, which he will not risk in the marts of trade, does not increase his capital, nor does it do him or anyone else any good, as long as it is hidden away. He may accumulate a little more by his own labors, but there must be the combination of labor and capital to create an addition to his store.

Brains, too, are necessary. The great inventions and the economic problems which have been solved to increase the world's wealth, have been due to brains; yet to carry out the plans of the thinker, the inventor and the economist, there must be both labor and capital. Morse invented a wonderful instrument which has revolutionized our business and social life; yet his days were wasted until he obtained capital and through it, labor, to demonstrate the usefulness of the product of his brain.

Employees must heed the popular doctrine that is being preached, and if they would prevent the reaction that will come, they should prevent the spread of the belief that labor and capital are opposed. This may easily be done by sharing with employees the wealth that is jointly made; for nothing quiets the cry of the discontented man as quickly as increasing his compensation and according him fair treatment. He does not want a sop thrown to him but he wants to obtain that which he believes is his by right.

### *Labor Unions.*

Labor unions have been beneficial to the world. Not that there have not been bad unions, but there have been many good ones and these have shown employers that consideration must be given to the laboring man and that he must be given a fair share of the earnings made by the capitalist, the brain worker and the workman, through their co-operation.

Labor unions in their fight for increased wages seem to forget or ignore, at times, some of the cardinal principles of economics, the laws of which are exacting. For instance, to quote one of the ablest thinkers in the engineering profession, the late A. M. Wellington, who, although writing on another subject, stated an economic law that is applicable to the case in question.

"It simply means *An Avoidance Of Waste,* either in saving money or in spending it. It simply means a recognition of the fact that every dollar and every day's work, which goes into the ground and does not bring something out of it, makes not only the individual, but the whole community the poorer. The welfare of all mankind, as well as the investor in the enterprises which employ men, depends upon the skill with which the investment in its constructive or manufacturing enterprises (destructive of existing capital) is kept small and the productive or earning power (creation of new capital) is made large. The difference between the two is the so-called "profit" (net addition to existing capital), which goes, indeed, into the control of those who created it by perceiving the (supposed opportunity or necessity) and using their own means at their own risk to supply it, but it is not, therefore, for the true interest of any person or class (labor unions—Author) to make it less by increasing the investment, for otherwise there is a waste which as it benefits no one, indirectly injures all. Not even the *laborer* who uses up a portion of the wasted capital is really the gainer for if, on the other hand, the capital spent (i. e., destroyed) for construction or plant (or wages—Author) be needlessly large, although the poor man gains, for the time being, wages which he would not otherwise receive from that particular enterprise, yet it is as if he was paid wages to turn a crank which ground no grist—his time and work go for naught. If he spend half his time in this way he must, in the long run, *do two days' work* for the wages of one."

Nothing shows better than this how capital and labor are bound together, nor illustrates better the certain effect of demanding more wages than the condition will warrant paying; that is, creating an artificial wage. If men are paid wages that they, together with capital, cannot create, although the individual may temporarily be benefited, yet in the end his class must suffer, and the day will surely come when an even balance will be struck.

### *Fluctuation of Wages.*

Wages are bound to fluctuate, due to many conditions. When they are low, many men are unemployed, and when they are high, men are difficult to obtain, and will be independent in their behavior and sometimes indifferent to their work. Some years past, a negro laborer said to the author:

"I remember several years ago that I was out of work and each morning for more than a month I applied for a job at a cotton mill, and when I was given a job at seventy-five cents a day, I was tickled to death and worked hard to hold my job. Now you are paying me a dollar and a half a day and if you don't treat me right, or I am dissatisfied at any time, I can go anywhere and get a job paying me the same money within an hour or two."

This illustrates the point and withal this man was an exceptionally good workman.

The ordinary method of rewarding workmen is not upon that basis of fairness that has been outlined and should exist, owing to the fact that ideal co-operation is not practiced between employer and employee. Men demand the highest wages and shortest hours that they dare to ask for, and employers pay the smallest wages that men will work for without protesting.

### *Rates of Wages.*

With contractors, an attempt is made to set a scale of wages for each job. Knowledge is possessed, or inquiry is made into the prevailing wages for men in various lines of work and either such wages are paid, or at the commencement of a job a less wage is offered, the contractor realizing that if the job lasts for any length of time wages will have to be raised. Most contractors pay the same rate to all men in each line of work. Thus all common laborers are paid at the same rate, concrete workers another rate, carpenters another and so on through a long list. This is to a great extent the contention of labor unions: namely, that all men engaged in the same work should be paid one rate. Many contractors claim that to pay men at different rates causes dissatisfaction among them, and that consequently strikes occur. For example, if one exceptionally good man is given an increase in his pay, others will demand it, and then the poorer workmen will go

on a strike for the same wages as the more efficient. With common laborers, this is to a great extent true. Nevertheless, if the matter is handled with care and judgment, these men may be paid at different rates.

Even with higher classes of labor it is sometimes difficult to set various rates for different men; but it can be done with them more easily than with common laborers, and some of the best labor unions have conceded that this method of paying men is right, provided the poor workman is guaranteed a standard or reasonable wage.

Indeed from an economic standpoint it is wrong to pay one rate to all men. Some are thus overpaid and others are underpaid. To illustrate. If an average workman can excavate 12 cu. yds. of earth in a day and the standard wage for this work is $2.00, then a man who excavates 14 cu. yds. should be paid $2.35, while the slow workman doing but 10 cu. yds. should get but $1.65. This, however, is what the labor unions object to—paying the poor man less than $2.00. If $2.00 can be proven to be the economic price for 12 cu. yds. of excavation, then the labor unions are wrong and again err in demanding that all laborers should be paid the $2.35 rate because the best men are paid that much. However, it is always difficult to prove what is the just and economic rate; so it becomes a matter of compromise, to agree on a minimum rate, which perforce becomes the standard wage and the basis of future deductions.

Besides paying standard hourly, daily, weekly or monthly wages there are a number of other methods of rewarding workmen to be commented upon.

### *Contract Labor.*

One method is simply that of letting the labor end of the job out by contract to the men. In contracting, this can produce excellent results. All materials, supplies, tools and machinery can be furnished to a gang of men and they can be paid a contract rate for the labor performed. The author has used this method upon a number of occasions. There are two ways of going about it. One is to pick out one or two men who have more ability than the others and to make them sub-contractors for the labor part of the work. These men then employ the other laborers at standard wages, and the contractor sees that they are paid. The

sub-contractors are paid a lump sum for so much work, or a certain price per unit of work. The contractor after paying the men turns over the rest of the money to the sub-contractors. The contractor saves in superintendence by this method, and as a rule the work is done faster and at less cost.

The second method is to contract with the whole gang of men, having it clearly understood beforehand who is to be in authority and what percentage of the money earned is to be paid to each man on the basis of making full time. By this means, instead of only one or two men being concerned with how the work is done and the speed made, the entire gang is vitally interested, and all not only put forth their best efforts, but are made to think, and to improve on the methods used. By this method, the author has had placed at $2.00 per cu. yd., masonry that he had estimated would cost $2.50, from the cost of the previous work done. Thus he added to his own estimated profit, and the men made about fifty per cent more than standard wages.

Men are always inclined to be wasteful of materials and supplies, but they are not likely to be any more so with this method than they are when paid regular wages. If they should show a tendency to be more wasteful, means of preventing it may be found.

*Piece Work.*

Piece work is another form of contracting for labor. A man or a gang of men are paid a given rate for certain units of work or a certain article or piece of construction. This method has been much used by manufacturers, and the results obtained have in many cases been very remarkable.

It is not, however, a method that is popular with working men. One reason is that the men, knowing the rate paid them, learn the selling price of the article and not realizing what the overhead charges and cost of selling may be, feel that they are being underpaid, when in reality they may be making much more than standard wages, for which they would be willing to work. Workmen make a mistake in this, although there are times when the piece work rate is too small.

Employers err in cutting the piece work rate from time to time when the men put forth special efforts to make extra money. It makes the men feel that they are being driven and defrauded

of their earnings. Piece rates must vary according to the market price of the product, but when the selling price does not fluctuate, the piece rate should not be changed. Careful studies should always be made before putting men to work on a piece work system.

*Tasks.*

Another method of paying men is to set tasks for them. By this means, they are guaranteed their regular wages and they work hard to finish their task. It can be an hour's or a day's, a week's or even a month's work. Not only are greater physical efforts put forth by the men, but their minds are riveted on the work, they find numerous ways of making it easier and obtain better results. The time saved by this method may be given to the men, but the men may again be benefited and likewise the employer, by giving them extra work to do and paying them for it.

*Task and Bonus.*

This brings us to a consideration of a bonus. The bonus the men earn when they finish their task and stop work is the extra time they have for themselves, but if they are paid for this extra time and given more work to do, then they earn a money bonus. This is the best method of paying a bonus, and the extra money so earned is not a loss to the employer, while it is greatly appreciated by the men. This method of rewarding workmen is applicable to many kinds of work. There is but little opposition of workmen to the system, and excellent results are obtained. In mixing concrete by hand, the author has gotten forty per cent more work done under the method than by day's labor.

*Contests.*

Contests in work also stimulate men to increased effort. These contests can be started among men working on regular wages, and by simply posting results the men will be stimulated to do more work. But it is right when men earn more for their employer, that they should be paid more; so prizes or a bonus should be the reward in these contests. However, when this is done it is well to set a task and to pay a bonus for all extra work in

addition to rewarding those who win out in the contests. Increased interest is shown by men in their work and the writer has known a construction force to be as enthusiastic over these contests, as a country is over a national yacht race.

### *Motion Studies.*

Motion studies are a means of increasing the efficiency of men. In nearly all work done there are useless motions used and time is consumed by things being spaced too far apart. Time and motion studies of every class of work may be made and much time may be saved, by experimenting to eliminate wasteful movements. Much has been written on this subject and the author promises to take it up at another time.

### *Coöperation with Men.*

There should always be perfect coöperation between an employer and employees. Men should be made to understand that suggstions concerning the work will be received and given proper consideration, that their welfare is being looked after and that no matter what grievance they may have, they can come to headquarters with it and it will be investigated. Disputes between foremen and workmen should be settled. The man in authority should be upheld in his work, but if he has done a wrong to any one, he should be made to see it and the wrong should be righted. When it is difficult for a workman to gain entrance into the office of a contractor, the workman will soon lose confidence in him, the only results that can be obtained will be through fear, and the men will work only enough to get their wages, caring little whether or not they have earned them.

### *Management of Detail.*

Much thought and attention are always given by contractors to all the important features of a large job. They decide whether steam shovels shall be used and how many trains will be needed to serve a shovel, or whether some other style of excavator shall be employed. For the concrete work, an elaborate plant is designed, and so on for all the various kinds of work to be done.

This is as it should be, and those who plan the best and equip their jobs with good plants should make a handsome profit, if their prices are right, but much money is lost, or if the contract shows a profit, much money that should be made is not made, owing to the lack of attention to details.

To a great extent, the details of carrying on a job are left to the various foremen employed. They are supposed to know how to handle economically the various problems that arise and the routine work, but in most cases they do not. If they did, they would not be foremen very long, but would quickly become superintendents or even contractors. Employers seem to overlook this very important fact, that the ordinary foreman must be given close supervision if the best results are to be obtained.

This is illustrated by the story of one of the most prominent railroad officials of the United States. As a young man he was appointed engineer in charge of maintenance on a section of a southern road that was ballasted mostly with sand and mud. Over the whole system the roadbed was rough, but as soon as a train reached the section kept up by this young man the difference was so great that everyone noted it and inquired the reason. The answer was, "Blank is in charge here." This piece of roadbed was soon known over the entire system, and Blank's promotion to superintendent, general manager, vice-president and so on up the ladder of success was rapid, and it was only a few years before his old section of the roadbed, under the management of a new man was like all the rest of the sand ballasted track.

### *Mismanagement.*

Much money is wasted on account of the lack of attention to many details of construction work. Recently the author has been watching the erection of a skyscraper in one of our large cities, paying special attention to the hauling of the structural steel. This work is done by teams of from four to ten horses with heavy trucks. A four-horse team is worth about $1.50 an hour on this job. Day after day, from two to six teams will be found waiting near the building to be unloaded. These waits vary from a few minutes to several hours. One day five teams were kept waiting two hours each. Thus this one item was a clear loss of $15, enough to be a handsome profit on the teams' work

for a day. This one item of waste on this job which is not yet finished, has been more than enough to pay a salary to a man who might have prevented it.

In demolishing a large building recently, to make room for the tallest office building in the world, the writer noticed that in tearing up the flooring from the floor joists, it was thrown into several piles by a gang of laborers, who afterwards picked it up, carried it to the side of the building and passed it down to the ground to be piled again before being loaded onto wagons to be carried away. Thus the flooring was piled twice. Once should have been sufficient, and the chances are that the work could have been so arranged that little, if any, of this flooring would have needed to be piled, which would have meant the saving of much money on the job. The same thing may be said of bricks torn out of old buildings. They are generally handled oftener than they should be. Every turn of the brick costs money, and it is money that really benefits no one.

This is especially so in bricklaying, and a well known eastern contractor has spent much time devising a system of brick laying that saves many motions in that ancient art, and some of the work previously done by bricklayers is performed by men who are paid smaller salaries. Thus, he has made it possible to have a bricklayer do twice the amount of work that he would previously do, without working any harder, by this means making it practical to pay these artisans a larger daily wage.

No other class of construction work has attracted the attention of engineers and contractors during the past ten years, as much as concrete; yet in spite of all the thought and study of concrete experts, some is wasted every day both on large and small jobs. When mixing concrete by hand men are allowed to handle their shovels in the same manner as they do in shoveling dirt, yet if the proper kind of a board is used for mixing and the men are taught to handle their shovels the right way, one and two turns of the mass can be saved, allowing from 25 to 30 per cent more work to be done with the same amount of labor.

Only recently the author had his attention called to the manner in which the materials are being handled on a large concrete job. The plant installation is a large one, and a very large quantity of concrete is mixed each day, yet the cement house is right up against the battery of mixers, the sand is stored beyond the

cement house and stone is all handled over the sand supply. A system of cableways is used to handle the sand and stone. Thus we find that the 4.5 cubic feet of cement which make up a cubic yard of concrete is handled the shortest distance. The 12 cubic feet of sand needed is handled over the cement, while the 26 cubic feet of stone which make up a yard is handled over the sand and cement. It is evident from this that time, labor and power are being wasted, and that a larger output could be obtained by having the stone storage closer to the mixers.

The same waste becomes patent in other details of concrete work. Crude and clumsy forms are used and held in place by twisted wire and props which interfere with economical work, when methods could be used that save both labor and materials.

Almost every construction job has some excavation work connected with it. Nearly every man feels that he is competent to handle earthwork, yet nothing is more difficult. The author's experience is that the more one has to do with earth excavation and the more study one gives to the subject, the harder it seems to solve problems of excavation. The last word will never be said or written on this subject. A common mistake frequently made in connection with earthwork is in the style of shovel used. In the United States the short handled shovel is used almost exclusively. These are either square or round pointed shovels. Many contractors seem to think it is a matter of indifference as to which is used. Each, however, is suited for a different class of work. The square pointed shovels should be used for earth, while the round pointed shovel should be used for earth and rock together. A man working in average earth will do more work with a square pointed shovel than with the round points, but the latter go under rocks and hold their load in rocky material better than the square pointed shovel, owing to the decided curve given to the bowl of the shovel, while the square pointed shovel is much flatter. It is for this reason that the same size square pointed shovel will hold much more dirt than the round pointed shovel.

For handling loose sand a large, flat, square pointed shovel should be used or else a small sized scoop. Coal should never be shoveled with anything but a scoop shovel. If stiff clay is to be spaded in order to save picking, which can sometimes be done, then a real spade should be used as it will cut a large chunk much wider than the blade of the spade, while if spading is done

in soft material the best tool is a wide, square pointed shovel. Naturally, though, a shovel not being built as strong as a spade, will not last as long, as spading quickly weakens a shovel in the center, just below the handle.

A short handled shovel should be used when men are worked in close quarters, or the distance to cast the material is short, or the height to which it is to be raised is small. Under other conditions a long handled shovel should be used. A man will do much more work with it than with a short handled shovel. For casting earth any distance it is much the best; also for throwing dirt to any height. The author has seen an able-bodied workman throw dirt out of a pit 18 feet deep. This shows what can be done with a long handled shovel, but it is not economical to throw dirt to such a height. This should have been done in two stages. The author has also seen a man cast earth from a berm ditch into a low railroad bank at the rate of 27 cubic yards per day, which is exceptional work, but such a yardage could not have been handled with a short handled shovel, even by the same man.

Many contractors believe that a long handled shovel is a "lazy man's tool," but it is not so. Any tool in a lazy man's hands is a poor tool, but it is the foreman's place to see that the workman handles his tools properly and that he works at a good pace. Often the men will object to using the long handled shovels. This is especially so of Italians. In Italy, very few short handled shovels are used, and Italian laborers are really used to long handled shovels, but they believe they will do less physical work with the short ones. This is wrong, for with less body fatigue they will handle more material with the long handled shovel. All of these assertions can be readily proven by any contractor by experimenting with the two kinds of shovels for a few days.

In using steam shovels, the mistake often made is that the crew in the pit is not large enough. The pit crew cannot be kept constantly at work, and as it looks bad to see men standing around idle, this crew is often made too small. However, when the shovel is to be moved forward, every man should work at top speed so as to get the shovel digging again as soon as possible. Thus one or two extra men, although idle at times, might save 10 to 12 minutes' time in moving in a day. This, with a two-yard dipper, would mean from 60 to 70 cubic yards of extra ma-

terial moved in a day, three or four times as much as would be needed to make these two men pay for their wages.

Steam shovels are often used in rock excavation, and do good work; yet there are times when it is more economical to go over the rock with the shovel, stripping it of all the earth and loose rock that can be readily handled by the shovel and then putting in a derrick car, equipped with heavy chains, derrick skips and grab buckets to handle the solid rock after it has been blasted.

Many steam shovels are today equipped with small air compressors and plug drills for breaking up boulders when they are encountered. Recently the author has seen boulders that had to be broken moved in front of the shovel, near to the loading track so that they could be drilled for blasting. This is a mistake, for it prevents the shovel from working while the drilling is being done. The boulder should be placed on the other side of the shovel, so that loading can go on without interruption.

Much money is lost and wasted in the breaking up of boulders as done by the ordinary foreman. He seems to think the only thing to do is to get rid of the boulder quickly. This is important, when the boulder is either blocking the work of a steam shovel or a gang of men, but otherwise the cost of breaking up the boulder should be considered as well as the length of time in which to do the work. There are six methods of breaking up boulders: (1) by means of fire and water; (2) by means of dropping heavy weights on the boulders; (3) by means of sledge hammers; (4) by "block holing," that is, drilling a hole in the boulder and breaking it with a charge of explosives; (5) by "mud capping," that is, by placing the charge of explosive on top of the boulder and covering it with mud; (6) by "undermining," that is, placing the charge of explosives under the boulder in a bed of mud, so as to confine the charge as much as possible. Of these various methods only two are used to any great extent, namely, "block holing" and "mud capping."

(1) The method of using fire and water is economical in some cases, but naturally its use is limited. When timbered land is being cleared up and water can readily be obtained, much money can be saved by this method of breaking up surface boulders. The boulder, however, must not be partly buried in the ground, as it will not heat enough to break, but will only crack. In digging cellars in towns and cities the few boulders encountered

can be broken up by heating them with waste lumber and then dashing water on them. A little practice soon allows one to gauge how hot the stones must be to break well. The author has used this method and has kept costs of the work.

(2) The method of breaking boulders by means of dropping heavy weights upon them can only be used when a derrick, locomotive crane or cableway is used. The weight is raised to a height of 20 to 30 feet over the stone and by means of a trip is dropped onto the boulder. Thus, this body of iron, weighing from 1,500 to 3,000 pounds, striking the rock a sudden blow, breaks it up so that it can be handled. Boulders of from one-half to three cubic yards can be broken in this manner by one or two blows of the weight. This method of breaking boulders can be used to advantage on city work where a derrick is used on the excavation, and is of especial use for quarry work. Besides these places, it can be utilized in heavy rock cuts and trenches, where a cableway, derrick, locomotive crane or other hoisting device is used.

(3) The method of breaking boulders by means of sledges is as old as the world. It is economical for boulders up to a cubic yard in size, but for larger boulders it takes too much time, and the use of explosives is cheaper. Sledges should not be too heavy and those weighing from 12 to 16 pounds will do better work than heavier ones. It is the quick, rapid stroke that causes the disruption rather than a slow blow. For small men, 12 to 14 pound hammers should be used, but for a large man a 16-pound hammer is about the right size. A man should always hit the stone with the rift as it breaks much easier. When many stones are to be broken and the boulders are large enough, two men working together and striking at the same place will do better work than one man working alone.

(4) Block holing boulders is a well known method of breaking them up. A hole from a few inches in depth to a foot or eighteen inches should be drilled in the rock and the explosives placed in the hole. If the entire charge can be placed in the hole more efficient work is done by the explosives, but frequently it is cheaper not to drill the hole so deep and place some of the charge on top of the hole, covering it well with mud. Boulders of all sizes can be broken up in this manner,

but for the smaller sizes, say a cubic yard or less, sledging and other methods should be used, as they are more economical.

(5) The "mud capping" of boulders is used more generally by foremen than any other method. It is easier and entails less labor than the other five ways, but it is the most expensive, as the amount of explosives needed is excessive. For these reasons it should seldom be used except when work is being tied up by the presence of several boulders. Then a few sticks of dynamite should be placed on top of the boulder, plenty of mud placed on the dynamite to cover it well and the fuse lighted.

(6) The last method of breaking boulders by "undermining" is but little used, although it is both quick and economical. In this case the charge is placed under the boulder and mud placed around the dynamite, after which it is fired. This method cannot be used when the ground on which the boulder is lying is soft or made up of loose material, as the force of the explosive will dig up the dirt and not break the boulder. A rock of a given size can be broken up with just half the charge by "undermining" that is needed for "mud capping," and the labor cost is but little more. The rock is not only broken up better but parts of it are often blown out of the excavation. The author has broken up and moved boulders containing 50 cubic yards or more by this method. Every contractor should teach this method to his foremen.

Upon one occasion, the author passed a gang of workmen engaged in laying a three-foot concrete sewer pipe in a trench about eight feet deep. All the work was being done by hand. Water was encountered in the ditch and laborers were put to work bailing it with buckets. Four men were employed in this manner and it is hardly necessary to state that this method did not keep the trench dry. For more than a week this bailing of water continued before a new diaphragm pump was installed. One man worked this pump and kept the ditch reasonably dry. The question is naturally asked, why was not this pump bought when the water first appeared in the ditch? The extra cost of the men with buckets for a week, amounted to as much money as the pump cost; yet through some mismanagement this pump was not purchased and installed when it should have been.

Another thing regarding this work was the fact that every-

thing was done by hand. Upon inquiry it was found that the contractor had ten miles of sewers to build, all of it being either terra cotta or concrete pipe of various dimensions, yet machinery was not installed. Further inquiry brought out the fact that the contractor had five or six forces at work in different parts of the city; so a visit was made to all points where work was going on.

It was found that two of the six forces were well equipped. They had a good pattern of a trench machine to handle all material, pumps, dump buckets, and all the tools needed to carry on the work quickly and economically. The other forces should have been similarly equipped. One gang may have been engaged in doing odds and ends of work and of course could not have used a trench machine, but if it paid to equip two forces, it would have certainly been good management to have outfits for the other gangs.

Another very noticeable piece of bad judgment on this same contract was the delay that occurred in nearly every case in building the man-holes. The excavations for these were made as the trenches were dug, but it was generally from three to four weeks before the man-holes were built. Meantime the holes filled with water, the banks caved in, and not only was the work made more expensive, but the foundation for the concrete and brick work was injured in many cases and stones had to be put in to keep the masonry from sinking. This could certainly have been prevented by looking ahead and providing both materials and masons to do the work promptly.

This can be done; for on another sewer contract where 12 miles of storm sewers were being built, it was done. Here the contractor bought his material upon starting the job, and let the laying of it out to masons, by the man-hole, paying them certain prices for a man-hole of a given size. The result of this was that the man-holes were built promptly, but a few days behind the pipe setting. This made a profit for the contractor and allowed the masons to make more than they would have made working on day's wages.

One very common error in management, especially in a permanent plant, as that used in quarrying rock, is the multiplicity of steam boilers that are soon located at different parts of the work. Often we find one boiler used for the crusher, another

for the pumps, and still another for the rock drills. Comment on this would seem to be useless, but for the fact that such conditions are frequently found. It is true that it is the result in most cases of the rapid growth of a business that possibly began in a small, simple way, and first one piece of machinery and then another was added as additional steam power was needed. Each boiler meant another fireman, so besides the increased coal consumption, the pay roll was increased more than it should have been.

The proper way would have been to have rebuilt the plant after the second or third addition to it, and to have so arranged the new plant that additional steam units could be added to the central plant as they were needed. When a new plant is built with boilers scattered here and there, it is the height of folly.

# CHAPTER IX.

## CONTRACTORS' OUTFIT AND PLANT.

THE horses and mules, the tools and machines owned by the contractor are known as the outfit or plant.

### *Selecting Plant.*

Next to obtaining contracts there is no more serious problem presented to the contractor than that of purchasing outfit or plant to perform his work. At one time, tools and machinery were spoken of almost entirely as "contractor's outfit," but today the term "plant" is used extensively, especially in connection with charges regarding this item of expense. No doubt the newer term will entirely supplant the older one.

The question of how much is needed and also the proper kind of plant should be a matter of careful consideration. Then, too, it is necessary to take stock of what outfit is already on hand and determine if it can be used to advantage on a new job. A contractor's experience must, to some extent, be his guide in reaching a decision on such matters. Also the amount of capital he controls will be a ruling factor. That mistakes are made in this connection need hardly be stated, and considerable money is lost by errors in judgment and through ignorance in selecting the proper outfit to use. Some contractors seem to believe that any makeshift is good enough, while in reality they are losing money by not having the proper machinery. Some expensive tool may have been used on one job, having been selected for its adaptability to that particular piece of work. For the next contract it is not so well adapted, yet instead of selling and trying a new style machine, or one of another size, the old one is worked, relying on the ingenuity of the contractor or the friendship of the engineer to pull the job through to a successful finish. Contractors as a class seem to be too bigoted and allow their prejudice to warp their judgment in this matter. There was a day when prices were high and conditions were better, so that almost any man could make

money at contracting, but that day has passed. To make money at contracting it is necessary to practice economy in the true sense of the word and to surround one's self with competent men and outfits suited to the work. Thus contractors should be on the lookout for new inventions and styles of tools and also try to adapt tools gotten up for other work to their own. They should always be willing to try new methods of doing work, where they are likely to prove profitable.

Engineers and contractors as a class seem prone to err in these things. They are guided to a great extent by precedent. "What have I done before? Where have I seen these methods?" seem to be the sole questions that influence many in arriving at all their decisions in regard to construction work.

*Prejudice Against New Machines.*

The most frequent mistakes made in this connection are in regard to tools and machinery. Many contractors seem to have a prejudice against new machines, or the adoption, for their work, of machines used for other purposes. It is very true that contractors and engineers have made great progress during the past twenty years in the use of machinery, but the progress has not been such as it should have been. Steam shovels have been manufactured for at least fifty years, yet it has been only in the past ten or fifteen years that they have come into common use. The merits of such a piece of machinery are not hard to see, yet many contractors seem to think that they were only meant for certain classes of work, i. e., when the amount of material to excavate is large. These facts have been disproved. The author knows of one case where a steam shovel excavating only eighty cubic yards per day, performed the work more cheaply than by hand labor.

In some cases, contractors seem obstinate in their contention when opposing the installation of new machines on work. A case is recalled in which a large number of short piles were to be hauled, and, upon investigation, it was found that the cheapest way was to use a large timber cart. One was accordingly purchased, but the superintendent was opposed to its use, preferring to use the ordinary running gear of a wagon. The only way to use the timber cart was to discharge the superintendent.

Contractors often act in a similar manner. Only recently a firm of contractors purchased a machine for a certain class of work. One partner bought it for the other to use after a thorough investigation as to its merits over all other machines adapted for that class of work, yet he could not prevail upon his partner to try the machine, the latter's excuse being based simply on misconceived notions, and an obstinate prejudice against what was to him a new machine. This is often the case even when machines have been on the market for a number of years and have been tried out by many other firms.

The probable reason why many engineers and contractors act in this manner is that there are many new inventions and tools placed on the market that possess little or no merit, and yet a smart salesman is able to present so attractive a discussion of their use, that sales are made, only to the sorrow of the purchasing engineer or contractor. The author once knew of a case in which a contractor was carrying on a large amount of light excavation, and decided to try out every new machine that was offered to him for that kind of dirt work. More than a dozen tools were thus tested and experiments made to determine their adaptability, with the result that every one was discarded, and the original methods decided upon by the contractor were used. This contractor was thus made conversant with these various appliances, as he would not have been if he had not tried them.

Engineers and contractors should remember that any reputable manufacturer or sales agent will always allow a fair trial of any new machine; that is, he will put his machinery on a job to be operated by the contractor for a reasonable length of time, and if if proves satisfactory, the contractor will buy or lease it, and if it is a failure the manufacturer will remove it at his own expense. When wheeled scrapers were first invented they were placed on jobs in this manner and a man was sent along to set them up and work them. The same thing has been done with elevating graders, steam shovels and many other tools. In the case of large and expensive machines this is still done.

### *Guarantees on Machinery.*

We hear much of guarantees on machinery. A guarantee seems to have a potent influence over the average buyer, yet the

guarantee can be worth very little unless there is something to back it, and that something is integrity. When integrity is behind the guarantee there is also likely to be money. The essential thing is to know that a machine is well constructed and made by a reliable firm, and this should be sufficient guarantee.

With a contractor these things are of great importance, for when a machine breaks down, the entire force at work may have to be stopped for some days. The guarantee cannot cover such loss. A guarantee is like the word of an individual. He may tell you something and if his reputation for veracity is good, he is believed, but if he is a worthless fellow and a well-known liar every one will be suspicious of his swearing ability. Reputable goods do not need a salesman's oath to sell them. It is generally believed a firm of reputation will only sell an article of reputation, one that they will not be ashamed of. A product that only has its guarantee to recommend it, can be looked on from the start with suspicion. The name, age and reputation of the manufacturer behind the goods is the best sort of a guarantee, as his prestige, gained at great cost, is too valuable for him to lose.

There should be only one condition when a guarantee is necessary, namely when there can be a reasonable doubt as to whether or not a machine or tool is adapted to some particular work. Then if the manufacturer has faith in his machine he should sell it, subject to the guarantee that the machine will do the work or it can be returned without cost to the contractor. This is done at times and shows the faith of the manufacturer in his own knowledge and recommendation. A clearer understanding of these things, both by purchasers and sellers, is bound to be a benefit to all concerned.

A man can satisfy himself as to improved methods and machinery by visiting construction jobs where they are being employed. A visit of a few hours will seldom suffice and it is not always well to go with the selling agent, but a trip of several days should be made so that a careful study can be made of the job and the conditions under which the work is being done. Many contractors stick too closely to their own jobs. It is right that any business man should pay close attention to his work, but even this may be carried to extremes. Every contractor should keep posted as to the new things in his profession, and one way of

doing this is to visit important construction jobs around him. Much can be learned in this manner.

*Mistakes Made in Selecting Tools.*

Even in the case of small tools and implements this is true. Many contractors seem prone to use only such tools as have been in use for years and to pay but little attention to improved styles of tools. This is quite noticeable in regard to wheelbarrows. There are now numerous styles and sizes of barrows made, that are designed for special work and savings can be effected by using these special wheelbarrows, yet many contractors only buy one style of barrow, and use this on all jobs. Thus a contractor using barrows for excavating foundations will use the same ones for the concrete work, for which purpose they may be entirely unsuited. The beds of barrows meant for earth are too shallow and not shaped properly for concrete, for with extremely wet mixtures only two or three shovelfuls of concrete can be handled without the concrete slopping out of the sides. Earth barrows are not even suited for the raw materials for concrete, but a wheelbarrow with a high front and sides, yet admitting of quick dumping of its contents, either over the front or sides, should be selected.

In most cases it is advantageous in hauling concrete to use a concrete buggy. These carry a much larger load and, if the proper runways are laid down, will allow of the concrete being handled much more quickly by the men, and at the same time considerable labor will be saved. The author knows of a foundation job, where an average of seven hundred cubic yards of concrete were handled each day with these buggies. The men not only carried a large load, but were able to move at a trot without letting up on this pace during the day.

For some work, even a larger amount of concrete can be carried by a push cart. Several such carts with automatic end gates for dumping are on the market and with these, from one-half to one cubic yard can be carried in a single load. A serviceable push cart, not only for concrete work, but also for earth excavation can be built by any contractor's blacksmith.

In many cases concrete or the raw materials for it are being transported by hand when conveying machinery should be used. Bucket and belt conveyors have been used quite extensively. They

can be adapted to many conditions, and are found quite economical for large quantities. Chutes and pipes are also being used for conveying concrete. Various patented hoists are used, and from the hoisting towers the concrete is distributed to the forms.

There are many kinds of concrete buckets and most of them are patented. Some are meant to dump under water, some are for use on cableways and derricks, some are designed to dump in narrow forms, and some on large, flat surfaces. Some are constructed so that they may be used as buckets and also as the bodies of dump cars. Orange peel and clam shell buckets have not been used in connection with concrete as extensively as they should. Whenever and wherever they have been tried money has been saved. For rehandling sand and aggregate they are valuable as they not only dump automatically but load in the same manner. When the concrete is discharged into the hoppers, these buckets may be used for placing it, allowing the mixer to work continuously.

Experiments have lately been made in conveying concrete through four-inch pipes by means of compressed air. Some of the experiments have been successful, while others have only been partially so; but there seems to be little doubt that concrete can be and will be transported in this manner, and that for some classes of work this method will prove economical.

### *Concrete Mixers.*

There are many makes and styles of concrete mixers on the market, and all of them no doubt possess some merit, but they differ very materially both in the quantity and quality of the concrete which they will mix. Then, too, they vary as to their maintenance and the care that must be given them. Some makes are frequently out of order, so that much money is lost by men waiting for repairs to be made. Then, too, some machines are poorly adapted to certain classes of work, and in buying and using mixers these facts must be considered. Likewise the method of charging should be taken into consideration. One thing seldom thoroughly investigated by contractors is the horse power needed to run a mixer. Mixers vary exceedingly in this respect. For small boilers exposed to the weather a single horse power saved means the saving of seven pounds of coal per hour.

Bins and hoppers, too, are useful and economical in con-

nection with concrete mixers. Not make-shift affairs, but well designed and constructed bins should be used. For most purposes hopper bottom bins are to be preferred. When this bin is divided into several compartments, to hold different materials, and is to be filled by means of dump buckets, then the top of the bin should be sloped towards the operator, who handles the buckets, so that he can see as he dumps the material, thus preventing it from being mixed. Bins can often be built in sections so that they can be taken apart, and assembled again after being moved, or they can be mounted on wheels entire and moved at will.

### *Wagons.*

Wagons are used extensively by contractors, and for so many different purposes, that the selection of the proper wagon is of great importance. For earth hauling and similar work, the patented dump wagons, of which there are many makes on the market, are superior to any other style of wagon. It is true that a very good substitute for a dump wagon can be made by using scantlings or poles for a bottom and 12 to 14-inch planks for the sides and an ordinary running gear. These are known as "slat bottom wagons," and for long hauls can be used to advantage, but a man on the dump is absolutely necessary as some one must assist the driver in dumping. The frame can be set in place just before the wagon is loaded. It takes about two minutes to dump a slat bottom wagon, while it is possible to dump a drop bottom patented wagon without stopping the team and latch up the bottom on the way back. It is easily seen that not only much time is saved when a large amount of excavated material is to be hauled, but less wagons will be needed.

Some writers have stated that slat bottom wagons are justified for long hauls, as the time on the dump needed to unload is necessary to spell the horses. On long hauls horses can be spelled, even with drop bottom wagons, and a man is saved on the dump. The only excuse for using slat bottom wagons would be that the amount of material to be hauled does not justify the purchase of dump wagons. Today, though, dump boxes to fit any running gear can be purchased, and used even for a small amount of material.

One objection to dump wagons is that they are of little use for moving any material that will not dump by gravity, nor are

the beds shaped for hauling material which comes in large pieces. There should be no question regarding the practicability of dump wagons when material that can be dumped is being hauled daily, but when wagons are to be used for other purposes, a contractor should have the ordinary wagons, with their beds and dump boxes for earth and such materials. Dump boxes are valuable, but for regular daily work they are not as economical as the dump wagons.

For some purposes rear end dump wagons should be used. There are a number of different styles made for various purposse. Most of them have higher bodies than the drop bottom wagons, but as a rule they are of greater capacity.

### *Dump Cars.*

The size and character of dump cars to be used for different works is sometimes a difficult problem. Cars may be divided first according to size. Those of three cubic yards capacity or less are classed as small cars. Other sizes range up to 40 cubic yards capacity and are classed as large cars.

In considering any car proposition one should bear in mind that if the contract is one that demands a certain style of car, and the job is large enough to pay interest on the amount needed to purchase the cars, naturally they should be bought, but if the amount of work is only nominal, then it may not be economical to purchase a special car, but rather one that will be adapted to the work and also be useful for other purposes. This rule is applicable to the purchase of any large amount of equipment.

Small cars for transporting earth, concrete and similar materials are generally more economical than carts, cars, wagons and other vehicles, for short hauls, provided there is enough work to be done to justify laying the track. This, however, is a small item, when "industrial tracks" are used, for these tracks come in sections, with metal ties fastened to the rails with clip bolts, and can be laid in position and fastened together quickly. Regular rails laid on steel or wooden ties can be used, and for small cars even a wooden rail proves satisfactory.

One advantage that small cars have over other vehicles for transportation is the fact that one horse can pull for more than one car. If the haul is short, even though the grade be steep, one horse will pull one car, while a second car is being loaded, and

will move the second one after returning the first to be loaded. Thus, at least one and possibly two or three horses are saved. Cars with a capacity of less than one cubic yard can also be pushed for short distances by men.

On level or descending grades one horse can often pull two or three small cars, so that they can be operated in trains. Hoisting engines may also be used for this purpose, and at times gravity can be utilized to move the cars, using power only in one direction or for a very short distance. For ordinary work both wooden and steel cars are used. The steel cars, however, dump more cleanly and are accordingly to be preferred for carrying concrete. Small cars are made in many different styles, yet they can all be grouped into two classes—side dumps and rotary dumps. All side dumps are either "one-way" or "two-way" dumps. A very common kind of two-way dump car in use today is the V-shaped, rocket car. This is easily handled by one or two men and can be readily tilted to load.

Rotary dump cars are especially useful in building embankments, as they can dump over the end of the bank, thus saving building a trestle from which to dump. Then, too, they can be loaded from any side, and since one end is open for dumping purposes, the car is lower, which is an advantage when loading by hand.

Large dump cars are used in connection with steam shovels or other loading machinery, or for ballasting track. Other styles of cars used for these purposes are flat cars and gondolas with swinging sides, which are unloaded with a large plow or unloader. The dump cars dump either through the bottom or the side, or both. Some have a great range of dumping, and spread the material as it is dumped, while others must have powerful spreaders to follow after them.

For steam shovel work the large patented dump cars do not seem to be in favor with most contractors. One reason, no doubt, is that the price is high, while another is that some are leased and not sold. There can be little doubt that one of the economic blunders made in most steam shovel work is that the cars used are too small. Even though the same yardage is carried in a train, the large cars mean more economical train operation, for the journals of the cars are larger and the wheels larger and better made. Brasses do not wear out so quickly, and the length

of the train being shorter, it is controlled by the locomotive more readily. As a rule, though, the yardage carried in a trainload of large cars will be greater than that composed of smaller cars. The smaller cars, such as four, six and eight cubic yards capacity, are generally built for a narrower gauge track than the larger cars. For some purposes the three-foot gauge is well adapted, but in the author's opinion, the standard gauge track is the best for most construction work. In the latter case, cars and engines are better balanced and operate more easily in proportion to their loads, the track laid is generally more substantial, and supplies of coal and other materials for the work can be hauled to their place of destination over the contractor's track. This last point alone may mean many thousands of dollars on an extensive job.

### *Small Tools.*

There is much money lost by contractors on railroad construction by failure to use power drills. In some sections drills are being used extensively and the use everywhere is growing rapidly. Even for light work hammer drills can be used. The cost of a drill and light boiler hardly exceeds $500, and its work would so far exceed that of men with striking hammer or churn drills as to more than pay the interest and depreciation in a year's time. Certainly power drills should be used on all tunnel work; yet even today tunnels are being driven by hand.

Even in such a matter as hand shovels and picks care must be exercised in selection. Picks vary much in their length and weight, and are pointed differently. Stone picks, railroad picks and contractor's picks are all meant for different kinds of work, and each is economical in its own place. Yet many contractors use the same style and weight of pick for all purposes.

The same thing is true in regard to shovels. Many contractors think any old shovel will do, but a different shovel is needed for concrete work than for earth digging or rock shoveling.

A great waste in a small item sometimes results from the use of the wrong kind of hand buckets. The one in most common use is the galvanized iron bucket, which is soon bent out of shape. A well made bucket should be used, and although their price may seem high, yet much money is saved with such buckets.

There are now sold a number of styles of good buckets manufactured especially for use by contractors.

### *Scrapers.*

Scrapers are not always used when they should be, nor is the proper kind always employed. In the western states scrapers are used extensively on railroad embankments and canal work; yet one seldom finds them among an eastern contractor's outfit. The conditions in the west are more suitable for buck scrapers, but they could be used to excellent advantage in the southern states and other parts of the east. Four-wheeled scrapers are very useful and economical tools, yet few contractors have used them.

### *Excavating Machines.*

There are many kinds of excavating machines on the market today; yet we see much work that could be done by machinery being executed by hand. This is especially so of trench work. There are a large number of very successful machines in use for excavating trenches and ditches.

Clam shell and orange peel buckets are very economical excavating tools. In connection with derricks cars and dredges their range of work is extensive. These buckets are built both for hard and soft digging, and as the number of men needed to operate them is small, the cost is very low.

### *Derricks.*

Derricks, although used for many kinds of work, are seldom employed for excavation, except cellar digging; yet they would frequently save money and pay for themselves many times on one job. For side hill rock work on railroads, or in solid rock borrow pits they could frequently be used. Almost any mechanic can construct a derrick and rig it up at little cost, especially where suitable timber can be procured. Such derricks will answer many purposes, but when large, powerful, quick acting machines are needed, a contractor will do well to purchase his derricks from some one of the many companies that manufacture this class of machinery, or submit his wants to them and allow them to design such derricks as will fill his needs. We can not be experts in all

classes of work, and although one may be capable of designing derricks as well as men who make a business of it, his derrick is seldom constructed as well. Frequently work is made to cost more by the use of a home-made derrick instead of one purchased from a manufacturer.

*Steam Shovels.*

On this subject, a fair sized book could be written, as many things should govern not only the working of a shovel, but also its selection. Many mistakes are made in purchasing steam shovels. Frequently large and heavy shovels are worked where light ones should be used and vice versa. When a contractor owns a shovel, bought possibly for a special piece of work, it is taken to a new job and worked in spite of the fact that it is not suited to the job, and that it would be cheaper to sell it and buy one adapted to the work.

The equipment of a steam shovel is of importance. The arrangements for serving fuel and water, lights for night work, compressor for drilling rock, pumps for keeping the shovel pit free from water, are matters for the closest attention. The same consideration should be given other machines, such as elevating graders, ditching and trenching machines, skid excavators, power scrapers and dredges.

Pile drivers and hoisting machinery should be selected with care. Experience counts much in the equipping of a job with a plant. It is done in most cases in an indifferent manner, although most contractors do not think so.

*The Value of Knowledge of Plant.*

That the above statement is true is evidenced by the fact that many contractors with large, well handled plants, lose money. This is due to a lack of knowledge in the selection of plant-equipment.

An understanding of equipment and an intimate knowledge of its application in the various fields of construction are prerequisites to success at contracting. This knowledge insures that the plant selected will be adapted to the work, and that the work will be done at the minimum cost and with expedition. The results obtained will count much to the contractor. One who possesses this knowledge will beat his competitors, for he will be able to

underbid them, and at the same time make a fair profit, since the plant used must, of necessity, form the basis for the prices bid and also for the time limit given for doing the work.

Contractors to be assured that they are right on this important subject should employ an expert to consult with. On the general proposition of plant, a civil engineer experienced in this line would be the man, but for compressor plant, pumping outfits and hoisting devices, he should turn to a mechanical engineer and for electrical machinery to the electrical engineer. The money spent with them will be well invested.

### *Purchasing Tools and Plant.*

It can be set down as an axiom that it never pays to buy cheap tools, for they will not stand up to hard work. Besides this, men will often be compelled to wait while repairs are being made, and in some cases men may be killed by accidents owing to breaks caused by poor materials or cheap workmanship. On the other hand, exorbitant prices are sometimes asked for certain grades of tools or for particular machines, and in most cases it is a waste of money to pay such extra prices.

There are many features to be considered, however. The reputation of a machine for adaptability and durability, should be given consideration. Then when spare parts are ordered, such parts should fit without extra work being done upon them. Also the manner and care taken in shipping such parts should be looked after as well as other features which mean money to a contractor.

In many cases contractors in purchasing small tools give little thought to the matter. A shovel is a shovel and a pick a pick to most contractors, yet there is a vast difference. It is the same with other tools. Money can be saved in giving the purchase of these tools the same thought and attention that is given to larger tools and machines.

When only small tools are used on a contract, as in side hill rock excavation, the amount of money invested in the outfit is small, but the same care should be used in selecting such an outfit as when large machines are employed.

It is hardly practical to repair most of the small tools. The cost of the material and necessary labor often exceeds the price of new tools. At times the worked-out tools can be used for other

purposes. For instance, an old ax can be hammered down and used to knock up the rings on two way dump cars.

Small tools should always be bought in large quantities for several reasons: First, in order to obtain the lowest price possible, which can only be done by a "factory delivery." Second, so that there will always be an ample supply on hand, not only to work the ordinary forces used, but also to be used by extra forces that may be found necessary in cases of emergencies. Third, that men can be changed from one class of work to another and not be short of tools. On the other hand, too large a supply of tools will make both foreman and men careless about losing and breaking them. For this reason, there should always be provided a tool house at some central point where extra tools can be stored.

When heavy machinery is used, it can be put on a job in three different ways. By actual sale, by lease-sale and by rental. Naturally the most economical method, under ordinary circumstances, is to purchase equipment outright, but this cannot always be done and there are circumstances under which it is better to rent. Renting contractors' machinery is very popular today. There are many concerns that make a special business of this, and own a large assortment of machines to rent. Machines are rented by the day, week, month, or year, the price of rental depending upon the length of time. There are some machines that are not rented on this basis, but upon the amount of work they do. Thus a charge is made upon a unit of work as a cubic yard. Rented equipment must generally be kept in repair by the contractor, but he is not responsible for the ordinary wear and tear. At times a machine is rented with the privilege of purchase. Then the rental paid applies to the purchase price; but to obtain this concession it is generally necessary to make such an agreement at the time of renting. Not only second hand machines can be rented but also new machinery.

### *Purchasing on Lease.*

Lease-sale agreements allow contractors to place extensive outfits on jobs with only a limited capital. The manufacturer or sales company leases the outfit to the contractor on certain definite payments under a form of contract which makes the property that of the contractor when the last payment is made, upon the payment of

one dollar or one cent as a consideration. In such cases a cash payment is made upon delivery of the bill of lading. The amount generally asked is one-quarter or one-third of the purchase price, although when pressed to do so, or when anxious to make sales, manufacturers will accept less, one-fifth or one-sixth of the purchase price. The rest of the payments are then arranged for by notes, bearing interest at six per cent, and payable monthly, bi-monthly or quarterly, these notes extending over a period of from several months to one year, although most dealers prefer to close up the business in six months.

The lease is a contract which provides that the title in the machines remain with the dealer or manufacturer until the last payment is made. It further provides that if the contractor fails to make payments as provided, he forfeit all right to the machines, and that he further agrees to pay all expenses of putting the machinery in the possession of the dealer. In spite of this, it is evident that the contractor has an equity in the plant equal to the money paid. The contract also states that the machines cannot be moved on to other jobs without the permission of the lessor.

Another method of buying outfit on long payments is by partial payment, when the title passes to the purchaser, who gives a chattel mortgage on the articles. Then if a payment is not made, the mortgage is foreclosed and the articles are sold.

When machinery is bought outright it is sold on open account and becomes the property of the purchaser at once, no matter whether cash is paid for it or not. The very lowest cash price is obtained by purchasing goods "bill of lading attached," that is, a sight draft must be paid before the bill of lading can be secured in order to obtain the goods from the railroad. Cash payments are also considered as being made within 10 or 30 days, for which discounts are often offered. Machinery is also sold on open account with time payments, some times reaching over several months. Naturally the dealer is not protected when machinery is sold on open account on long time, if misfortune should overtake the contractor; nevertheless, much business is done on this basis and manufacturers seem to lose little by it.

In purchasing second-hand machinery, unless bought on a lease sale agreement, cash is paid either upon making sale or upon bill of lading. Machinery bought at second-hand is seldom as satisfactory as new machines, unless bought from a second-hand

dealer who has a shop to rebuild and repair all of his machines after they have been in use. To buy old machinery from another contractor, or machinery which has not been put through a good shop often means to buy trouble. Some tools or machines, such as wheeled scrapers and boilers seldom prove satisfactory when purchased second-hand.

*Plant Charges.*

There are few small tools, except such things as hydraulic equipment which has a life of more than a year, that should be charged to plant or outfit account. Small tools are generally used up on a job of any length, so that the number carried to another contract is small. Such tools should be charged to an expense account. The author, in carrying on contracting, calls this account "expense of work," which really covers the direct cost of carrying on the job. It is to this account that all small tools are charged.

Tools that last some years and heavy machines are all charged to "plant account." Repairs made to such machines should not be charged to this account, for although they are a direct expense on the plant, yet they do not add to the original value of the machines, simply being an expense that assist in maintaining a value to the plant.

These repairs and renewals could be charged to expense of work, for in the end they are a direct expense on the work, but inasmuch as it is advisable to keep a separate account of such items, they should be charged to an account known as "repairs and renewals." From this account it is then possible to tell the cost of repairing and renewing all machines and tools, or any special machine or tool. To this account should also be charged all shop and blacksmithing expenses, completing the account with the item of labor.

*Depreciation of Plant.*

Another important item to consider is depreciation of plant, and with this comes the interest on the capital invested. In ordinary business sums of money so invested are counted upon to pay six per cent interest yearly. This interest in manufacturing plants is made by the machinery, while in mercantile business it comes from the sales. In the contracting business this interest must be

earned from the work of the machines and tools purchased and should always be included in a proposal for a new contract.

As to depreciation, the life of machinery used in construction work is from five to twenty years, according to the kind of machinery and the nature of the work it has to do. Drills and similar small machines will last from five to ten years with ordinary usage. A modern steam shovel, working in earth, will do good work for fifteen years or more, but the same shovel digging continually in solid rock would be used up in less time. In view of these facts, it is essential that a contractor should keep an account on his books to show the depreciation on his plant, so as to make the proper allowances for this item in submitting bids or making estimates.

One account, frequently overlooked, not only in contracting but also in other business is a sinking fund. The money to buy a new machine, when an old one is worn out and becomes worthless, must come from the work of the old machine, or else the capital invested is depreciating. Money should be laid by each year for this purpose. Thus the following accounts should be in every contractor's books: When a machine is purchased it should be charged to the plant account. The freight and installation should be charged to the expense of work account of the job on which it is used. At the end of a year six per cent of the cost should be charged to the interest account on plant. As repairs are made these should be charged to an account of repairs and renewals. The depreciation of the machine, theoretically, will be equal to the original cost divided by the number of years the machine will last, which amount should be credited to the sinking fund account. Practically the depreciation will be greater in the first year than in the succeeding year, as the instant the machine is bought and installed it is considered as second-hand machinery. It would be well if the sinking fund could be set aside and allowed to draw interest, but contractors cannot afford to do this, and the money may earn more used in the business than if invested in other ways, but it should be kept account of as though it were borrowed money and should be credited with a fair rate of interest.

### *Percentage to Cover Plant.*

Ordinarily, if the outfit is kept busy throughout the entire year, these items will be approximately as follows: six per cent for

interest on investment, eight per cent for repairs and renewals. Assuming the average life of a machine as ten years, the sinking fund charge will be ten per cent, which will give an aggregate of twenty-four per cent. Taking three hundred working days as making up a year's work, this will give a per diem charge on a $10,000 machine of eight dollars. Should the weather and contract permit of the machine being worked only 200 days the per diem charge will be increased to twelve dollars.

When tools or machines are bought on a lease-sale agreement the method of keeping the account is similar to the above, except that the interest paid on the notes should be charged to the expense of work, or to a separate interest account, but as the machinery ultimately becomes the property of the contractor it can be treated as bought on open account.

When the plant is rented these various accounts are not necessary as all the rental is charged to the one account, expense of work, or a separate rental account can be opened.

Some contractors make it a practice to sell machinery after using it a few years and then purchase new as it is needed. When a price equal to or greater than the difference between the cost and the amount set by in the sinking fund is obtained, this method is to be commended, both from a financial and working standpoint. The author when engaged in contracting gladly sold anything that he could, provided it did not interfere with his work. This is especially so of mules and horses, as with hard work they quickly play out and to do efficient hauling young stock must be used, except for a few classes of work. Horses and mules should be renewed every few years.

The depreciation of plant is always difficult to obtain. One large firm of contractors uses the following "Arbitrary percentage of Reserve Depreciation."

MONTHLY PLANT DEPRECIATION.

| | Per cent. | |
|---|---|---|
| Locomotives | 1.1 | Standard and narrow gauge. |
| Cars | 1.1 | Standard and narrow gauge. |
| Track | 1.1 | Rails, ties, frogs, switches, cableways. |
| Excavators | 1.1 | Steam shovels. |
| Machinery | 1.1 | Compressors, hoisting engines, rock drills, pumps, concrete mixers, pipe fittings, tanks. |
| Implements | 2.0 | Scrapers, wagons, carts, buggies. |
| Tools | 5.0 | Picks, shovels, blacksmith's tools. |

| | | |
|---|---|---|
| Stable | 2.0 | Horses, mules, harness. |
| Hotel | 2.0 | Cook house, bedding, tents. |
| Boats | 4.0 | Boats, scows, docks, marine equipment. |
| Furniture | 1.1 | Office and shop furniture and fixtures. |
| Real estate | 0.5 | Real estate, buildings, fence, yards, walks. |

These do not include any current repairs or interest on the investment. They are called arbitrary charges, and it can be assumed that they are to some extent based on this firm's experience, but the author would take exception to most of them. As previously explained, small tools should not be included in this list. Ties will show a greater depreciation than listed, so will some of the other equipment; yet the list has some value and can be used as a guide by those who have no definite figures.

Some contractors in keeping cost records put their teams down at a given rate per day, just as though they were hired. This is an easy method of keeping costs and of comparing various cost records, yet as this shows a profit on team work it is manifestly wrong to charge the teams to the plant account, and this eliminates estimating a depreciation on the mules, horses, harness, wagons, etc. The better method then would be to open a team account, which if handled properly, should show a profit. If horses and mules are charged to plant account then only the cost of maintaining them, interest and depreciation, should be charged against the work.

It frequently happens that trestles, bridges, railroads and wagon roads must be built to carry on construction work. Some contractors make it a practice to charge the cost of these structures to their plant account. They have to buy right of way and do grading and they reason that the railroad takes the place of teams that would be bought and charged to plant account. This the writer believes is wrong, for the plant charge against the work and the depreciation of plant is made excessive. The road is not plant, although steel bridges, rails, etc., can be considered as plant, for they can be sold, or used on another job, but the rest of the road or structure is a dead expense to the job and should be charged to the expense of work account.

One eastern contracting firm charges the building of railroads and other structures for construction purposes to their plant account, and at the end of the job they distinguish the ordinary plant, like tools, stock, machines, rails and other outfit, as "available plant" and the amount charged for railroads as "unavailable plant." The depreciation on all unavailable plant is in all cases

100 per cent. This on a job lasting only two years would make an excessive charge on depreciation and of course could not be charged up to a sinking fund. This alone shows the fallacy of this method of keeping plant account.

These various features of plant charges are of importance, and when treated properly, a contractor can easily tell upon what basis he is working and if he is actually making a clear profit on his job instead of using up his capital.

*Life of Plant.*

Very little data has been published on the life of contractors' plants. Some information has been gleaned from the records of railroads and manufacturing plants, and an attempt has been made to adapt it to contractors' equipment, yet only a general idea of plant life has been obtained. There is nothing accurate on the subject. Information on this subject derived from other sources, can not be adapted to contractors' outfit. For instance, take the life of a locomotive on railroads. They are handled by fairly competent men, cleaned up in the round house at regular intervals, taken into the repair shops and given constant inspection, while a contractor's locomotive is handled in most cases by an incompetent man, cleaned but little and seldom repaired, rarely being sent to a shop, unless sold. So it is with steel rails. They are laid on a railroad and not disturbed for years, while those owned by contractors are laid and relaid, the track is not kept in shape and it is thrown and twisted in all directions. Accordingly the life of rails is shorter than when used on railroads.

Some tools can actually be used a long time, but they become so worn, that the service given is poor and the repairs are expensive.

Small tools, with the exception of bars, some kinds of hammers, jacks and a few other implements, seldom last over a year, and few of them are carried from one job to another. Some contractors repair small tools, while some say it is more economical to buy new ones. With a competent blacksmith, tools can be repaired more cheaply than new ones can be bought and in many cases they are better than new tools.

Plows last from one to five years, according to whether they are light or heavy plows. Scrapers have a life of from three to five years, though if they are well cared for they may last longer.

Most concrete mixers last about five years. They will do work longer, but the cost of maintenance is excessive and the time lost waiting for repairs is an expensive item.

Light excavating machines, such as graders and elevating graders, last from five to ten years.

Heavy excavating machines, such as power scrapers, dredges and steam shovels, have a life of from ten to twenty years but must be rebuilt at least once, if they are expected to last over ten years and give good service.

Hoisting engines, cable way outfits and similar machines have a life of about ten years.

Locomotives and traction engines, steam rollers and such equipment last from ten to fifteen years, and the best makes even longer.

Cars last from three to ten years, but need constant repairing after the first year.

Small drills last from three to five years and well drillers ten or more.

Compressor plants and other power plants, with the exception of boilers, last at least fifteen years. Boilers seldom last that long on contract work unless rebuilt.

Pumps last from five to ten years and, if good care is taken of them, even longer.

Horses on contractors' work last from five to ten years. However, on scraper work their lives may be as short as three years.

### *Selecting Horses and Mules.*

Although traction engines, gasoline tractors, automobiles and even dinkey locomotives are replacing horses and mules in contract work, yet the horses are used extensively and will be for many years. Some contractors prefer horses for hard work and others give the preference to mules. In some sections of the country, mules are used exclusively, while in other parts a mule is seldom seen.

### *Mules vs. Horses.*

Mules, as a rule, cost less to feed and take care of than horses. From careful records kept of feeding stock, it is shown that a saving of from ten to fifteen per cent can be made on mules over

horses. Then, too, mules can stand rough treatment and neglect better than horses, although that is no reason why they should be submitted to it. Mules' feet must have more care than those of horses. It is more difficult to shoe them, especially for work on hard pavements, and their hoofs can be much more easily ruined by severe trimming, or not enough trimming. Shoes should be shaped so as to keep the hoofs spread, otherwise they will narrow near the frog and materially affect the animal in walking and drawing loads. Horses' hoofs can stand more water and dampness than mules'. A damp stable is a sure forerunner of hoof diseases, even more for mules than for horses.

Mules, though, can travel over much rougher ground and draw heavier loads than horses can. They pick their way out much better, with less injury to themselves. As a rule, mules of the same weight as horses are faster walkers, but they do not trot as rapidly. The average mule with a load does not want to go out of a walk, while a horse will. A horse will walk with a load about two hundred feet a minute, while a mule will cover about two hundred and twenty feet. Mules are often quicker in starting than horses, but in most cases they have not the grit that horses possess and if the load is not started at once they are ready to give up and must be made to pull. Horses will stick to the load until it starts.

### *Selecting Stock.*

Understanding these things, mules and horses can be selected for the work for which they are best fitted. For plowing, especially with four or more animals on good ground, horses are much better than mules. For plowing down slopes or rough, unbroken ground, mules are better. Mules will walk among the rock stumps and stubs more easily than horses, and they are not as likely to break the plow or their harnesses.

Horses work well in scrapers, but mules do better work, since they walk a little faster and can climb up and down slopes much more readily. The author has seen mules step from a perpendicular four-foot bank without hesitating, while every time the horses approached it, they stopped and had to be made to go down. Horses make much better match teams for loading scrapers than mules. For scraper work, the stock should be young and should weigh about a thousand pounds each. The best stock the market

affords is none too good for this work, for few animals can stand up under it for much over four or five years, if used at it continually. In three or four years they begin to get slow at the work. Poor teams are used up in a few months' time and are poor economy. Scrapers, drag wheels or wheelers are hard on stock.

For dump wagons hauling earth, etc., in contract work, either horses or mules can be used. Mules travel a little faster, but horses approach and follow an elevating grader, or go under the dipper of a steam shovel better. As previously stated, over rough ground, mules are to be preferred.

For wagon hauling on roads and streets, both horses and mules will do good work. Mules are better for country roads than on paved streets, but for a single, two-horse team there is little difference, except that old horses do this work better than old mules. With a single two-horse team, some factors favor horses and others mules, but for very heavy handling when four or more animals are used, horses give much better service. Then, too, horses adapt themselves to new work more quickly than mules. For wagon work, good stock should always be bought; but even for very hard work they last much longer than at scraper work. For this reason, much old stock is at work in wagons.

For carts to be used in construction work, good stock should never be purchased. The ordinary "plug" stock is good enough for this, especially in rock cuts where carts are used the most. The work is not particularly hard, and fair "plug" stock with good teeth and feet can be built up on such work. The writer has bought new down "plug" stock and after using the animals on carts for a year sold them in the same community in which they were purchased for about twice the buying price. Animals worked in carts on high embankments are frequently backed off the embankment or run over the edge, with the result that they are killed by having their necks broken. This is as liable to happen to a $250 animal as to a $75 one.

Mules and horses both work well in carts and with proper training can be handled with but little driving. Light weight animals can be used, but heavy horses weighing up to 1,200 pounds are better. Heavier stock than this are too slow and clumsy for carts.

For cars, small mules give better service than horses. When two or more cars are coupled together, heavy mules should be

used and occasionally it may be necessary to have two mules on one train, but as a rule, it is better to split up the train so that one animal can pull it.

*Training Horses.*

The efficiency of construction work can be improved by the proper training of horses and mules. Few contractors give any attention to this feature of the work. Many contractors allow teams to be backed up a great distance, which is hard on stock and consumes much time, not only for teams but also for men and machines. In many cases, this backing is not necessary. In open cuts, cars can be so handled that backing is almost eliminated. Runways can be made for wagons so that backing may be reduced to a minimum.

Horses and mules can be taught to start off at a signal and to take certain positions when returning with empties. They can be so trained on some classes of work, that one driver can handle two teams, for the animals are easily taught to follow. Mules are frequently trained for small car work and learn to walk between ties and to change from one side to the other to keep the cars on the track.

*Hired Teams.*

Many contractors own their own stock, while some hire all their teams. Caring for and feeding horses and mules seem to be easy tasks, yet many contractors lack knowledge on these subjects and it is difficult to obtain a competent stable boss. The fact that on any job where fifty or more horses are used, there are generally a number laid up, is evidence enough that this statement is true. Today teams are at a premium. Hired teams bring five and six dollars nearly everywhere and in some places as high as nine dollars a day is paid for a two-horse team. The feed and care of a horse and other expenses seldom exceed a dollar per day, so that the prevailing price for a team nets the owners a nice profit. The question whether to own teams or hire them is often discussed by contractors. Owned teams, when idle, quickly "eat their heads off," but at times it is almost impossible to hire enough teams.

For short jobs, it seldom pays to buy teams, but if a contractor owns a few horses or mules it is a great help. For long jobs it is better to own teams. Some contractors make it a prac-

tice to own a fair number of teams, enough to cover the ordinary hauling on their jobs, and to hire extra teams when they need them. When all teams are hired, both the team owners and drivers act very independently and move their teams slowly. The drivers will not always obey instructions but continually make trouble for the foremen, for they know that the foremen cannot discharge them; he only can send the team home, at the risk of interfering seriously with the work. If only a few teams owned by the contractor are worked with hired teams, the effect is beneficial, for they will set the gait and pace for all.

### *Stables.*

Contractors in a city can have a regular stable for their stock, but on jobs in the country, except when a barn or stable can be rented, they are as a rule compelled to house their stock in temporary stables made of canvas or boards. It is inadvisable to make a center aisle through the stable or corral. The space may be used to better advantage for the hay rack and feed boxes. This space should be at least four feet wide, with the rack built of slats so that it may be readily cleaned, and so that air may at all times circulate through it. The feed boxes should also be constructed so as to admit of frequent cleaning. The center aisle is not needed, since the stable boss can place the feed for the stock while the stable is vacant. Nine feet should be given to a mule or horse for standing room. Less will do, but to enable the animal to lie down and rest this much is needed. An aisle four feet wide should be made on each side of the stable and a rack three feet wide and four feet high built behind the aisle, of slats or poles. This rack, extending the entire length of the stable, will allow of each animal's harness being placed directly behind it, so as not to have it confused with other harness, and will be found of more service than pegs, as passing men or mules are not so apt to brush the harness to the ground. It will also be useful in cleaning or oiling the harness.

The roof should extend two feet beyond the harness rack to protect it from the weather. The width of the roof necessary for such a stable will be 20 feet on each side, making a total width of 40 feet.

During the summer months it will not be necessary to have sides to such a stable, for the stock will be cooler without them,

but in the winter, sides may be added. Without sides, the manure can be thrown out under the harness rack without much labor. In winter the manure can be disposed of through openings made in the sides for that purpose. With such a stable the stock enters at one end. The other may be used for the storing of feed, extra harness and repair shop.

When a contractor is permanently located or has a job lasting for some years, he can have a much better stable than this. Regular stalls of ample width can be built and a sanitary metal feed box and a watering trough can be placed in each stall. The watering troughs should be so arranged that fresh water can run into them and the stale, dirty water be carried away. A large overhead iron rack can be used for hay, and the hay placed in it from the floor above. Be certain that the stable is well ventilated. Few stables are, and in warm weather, poor ventilation keeps the horses from resting, when they are lagged out. Protect them from flies, too, as much as possible. The easiest way of doing this is to keep the manure cleaned up and stored under cover.

The floor of the stable where the animals stand should never be of concrete. The best material is stiff clay, well rammed. The next best material is planks kept in good repair. No matter of what material, the floor should be kept dry. Behind the stall a gutter and aisle can be made of concrete, and then the two can be washed with a hose and kept clean. Harness in such a stable can be kept in a room built for the purpose, on racks, pegs or in cases. Each should have a number, which should agree with the number on the stall, so that even a new driver can find the proper harness. Blankets, brushes, curry combs and such things can be kept in the same manner. A special cupboard should be kept for medicines, and the stable boss should have charge of this and carry the key.

The stable should always be kept dry and warm, or the animals will frequently suffer from dangerous lung and throat troubles. A cold stable means less work from the stock and a larger feed bill. Remember that horses suffer from indigestion as men do, while wet ground and stables injure their feet and legs. Great care should be exercised to get a well drained piece of land for a stable, and during the winter months to keep the inside dry, so that when the animals come in wet from working, in the rain and snow, they will have a dry place to stand at night.

Whenever it is possible, build a yard around the stable and

have troughs of running water placed in it. This arrangement will be of great use, and will mean but little additional expense. Provision should also be made for washing the animals' legs and shoulders. The stable should be cleaned out early in the day so that the ground may dry out as much as possible by night. This is the first work that the stableman should perform in the morning after the stock has gone to work. Bedding, when it is used, should not be put down until evening.

### *Feeding Horses and Mules.*

The feeding of horses and mules should be given close attention. The general method is to give each animal a certain measure of grain for each meal, whether he eats it or not, with no thought as to how much each particular animal needs. This is the wrong way to feed hard working stock. There is as much individuality in the appetites of horses and mules as in those of men, and consequently what will satisfy one, may not content another. Until he gets to know each one and the amount of food it needs, the stable man should keep a record of each animal and feed it accordingly. There can not be too much care and judgment shown in feeding stock that has to perform hard work.

Give them enough to satisfy their appetites, but not enough to allow them to waste it and mouth it over. All grain left in the feeding box should be removed, before putting in new, as the old is made damp from the saliva of the animal and soon sours, and causes indigestion. The feeding boxes should be cleaned each morning when the rest of the stable is cleaned. When hay is placed in the rack, it should be shaken until it is loose, especially if it is baled hay. All old hay in the rack should also be shaken up. This will take the dust out of the hay and allow the animal to pick it up more easily, and will admit of the air properly circulating through it. At least once a week all dust and dirt should be cleaned out of the bottom of the racks.

The ideal order of feeding draught animals is, first, water, then hay followed by grain. This is so, for the reason that grain is for the most part digested in the stomach and hay in the intestines, and the passage of the hay through the stomach carries with it a great deal of the grain, if it has been fed previously. So, too, water given immediately after eating will wash the food from the

stomach into the intestines before the gastric acid has had time to act on it.

It is not altogether practical to feed contractors' horses in this manner, but it can be approximated. In the morning, some chopped hay can be given to the horses and within a half hour a fair sized feed of grain. At the noon hour in very warm weather, hay alone can be fed, if the time of feeding is short, say twenty minutes or half an hour. In the winter time, grain should be fed. If the feeding time is longer, say one hour, chopped hay and grain should be fed. Any contractor can purchase a hay chopper, and with a gasoline engine do his own chopping, knowing then, that he is getting first-class chopped hay. For the evening meal give the largest feed of grain and let the stock have it after drinking water. Then, about an hour afterwards give them hay. This should not be chopped, as the change will be pleasant to the animal and there is plenty of time for them to pull it apart and eat it. Some horses will eat hay for a good part of the night. Then a little chopped hay in the morning satisfies them. To sprinkle a little water on the hay, especially the chopped food, gives a relish to it. Water should be given the stock between meals as they require it. If plenty of water is given between meals they will not require so much at meal time, and their food will be more easily digested. Water often, a little bit at a time, when a horse is tired. With hard work, hay should be fed sparingly. The hay ration should not be increased with increased labor; the grain should be. Too much hay heats a horse, crowds his lungs, makes his wind short and may produce heaves. If horses have heaves, cut out the hay ration except a small amount of chopped hay, mix with it a little bit of fat salt pork, chopped up, and sprinkle it all well with water.

The question is frequently asked, "What is the best grain to feed contractors' horses?" A variety of grains is best, although certain grains will be fed oftener than others. Corn is richer in fats than oats. Both should be fed. In the summer time more oats than corn, in the winter more corn than oats. Barley is an excellent food for horses, but it is quite fattening. In warm climates, oats, the best clipped white oats, should be given the preference. Two-thirds cracked corn and one-third oats mixed together makes an excellent winter feed. Whole kernels of corn and corn on the cob should be fed as a change for stock, as well as mixed and prepared foods and occasionally hard and soft foods. They are all

an aid to hard worked horses and mules. Great care must be taken in both buying and storing mixed foods and cracked corn, as it quickly sours from heat. Much corn that would not class well, when whole is frequently cracked to bring better prices. For these reasons the author does not favor mixed food and cracked corn for general feeding, preferring to buy corn and oats and then mix them. Corn must always be fed with care, especially to hard working stock. Remember, that the best hay and grain that the market affords is the cheapest to buy. Second grade foods give poor nourishment, and the animals waste much of them. Number one Timothy hay should be used, but now and then should be mixed with good clover. Alfalfa makes good feed, but meadow grass has poor nourishing value. Hardworking stock should be allowed to pasture whenever possible, but not too early in the spring.

### *The Care of Horses and Mules.*

When horses are brought into the stable they should have their harness taken off at once, and should be allowed to roll on the ground if they wish to. See to it that bottles and glass are not thrown on the ground where the animals are accustomed to roll, otherwise they will cut themselves. If necessary, then have them washed off. Their legs should always be washed when muddy and their shoulders when they are in bad shape. After they have stood long enough to dry, then the currying and cleaning of the animals should be done. A well groomed and cleaned horse or mule means a better working animal, as well as a healthier one. At least half an hour to an hour should be consumed in this work. The stable boss should inspect each animal before the driver is allowed to leave the stable. In winter time the horses and mules should remain tied in their stalls all night, but during warm weather, at about ten o'clock in the evening they should be turned out into the stable yard, but they should have access to the stable at all times. This will allow them to go get water during the night and also to continue eating. Rock salt should be placed in the yard so that they can lick it when they wish. Towards midnight the majority of the stock will have finished eating and after drinking and licking salt they will find a place to rest.

Contractors' stock must be gotten out early in the morning, but the stable boss should not go into the stable before it is abso-

lutely necessary. Sleeping animals awake at the least sound, and for this reason many people think that horses seldom sleep; but this idea is erroneous. Horses need sleep as well as men, and the more undisturbed rest horses have, the better work they will do. The man who watches out for them at night should not sleep in the same tent or shack for his movements or snoring will disturb the stock. He should, however, have his sleeping quarters near the horses and mules to hear them, if anything happens. The night watchman should go near the stable during his watch, but not into it unless it is necessary. The horses should not be roused up in the morning more than an hour and a half before they are to leave the stable. While they are eating they can be curried and brushed and their harness put on them.

In the middle of the morning during the warm months, the stock should be watered. At noon do not take the animals to the stable unless it is right at hand, but feed them on the work, so that they will have all the noon hour for rest.

All the horses and mules should be kept clipped during the entire year as they are more easily cleaned and are not as likely to catch cold. In winter, blankets should be provided for each animal and the stable boss should see that they are used. Unclipped horses readily become over-heated. They also gather a great deal of mud on their legs during the muddy season.

Horses and mules working in wheeled scrapers have their shoulders and necks made sore from the jamming of the collars, as the tongue of the scraper rises and falls. It is very difficult to prevent this jamming, but it is possible to keep the animals' shoulders and necks well. This can be done by washing their shoulders each evening with warm water saturated with salt. When the water is hard, add a little powdered borax to soften it. The water can be heated in large iron kettles near the stable or corral. The use of this solution will keep the animals' shoulders clean and so harden them as to prevent the sores from appearing. This treatment should be given without fail every day that the animal is worked.

*Harness.*

Harness should always fit an animal well. Shoulders can not be kept well under any circumstances if the collar does not fit. Some steel and aluminum collars will be found to give good re-

sults, but the author finds that a good leather collar, leather lined, is about the best. Canvas-lined collars should never be bought. Fit the collar to the mule's or horse's shoulder and then let it soak in water over night. The next day place it on the animal and see that the hames are properly adjusted and the collar will assume the shape of the animal's neck and will always fit him. This collar should never be used on another horse or mule. A pad should never be used to make a collar fit, nor for any purpose except when a sore appears. In warm weather pads cause scalds, which are ugly sores to heal. The inside of the collar should be kept clean, and this is the great advantage of metal or leather-lined collars—they can be washed and scraped. All straps and buckles should be properly adjusted, for horses cannot do good work when their gearing is either too tight or too loose. Trace chains should be covered with leather piping. Each animal should have its own harness and the driver should not be allowed to change it.

All extra harness should be kept in a room or tent, set aside for that purpose. A good repair kit should be provided the stable boss, with a supply of rivets, rings, buckles, harness leather and so forth, and all damaged harness should be repaired promptly. He should also have on hand harness soap and oil so that on rainy days, when the horses are not worked, the harness can be properly cleaned and oiled. Many successful contractors make many parts of their harness, not because it can be done cheaper, but because it is better and lasts longer. Long and heavy lines for scraper teams can frequently be made by the stable boss to give better service than bought lines, and sometimes for less money. Many harness makers are learning the needs of contractors and are now making harness that is better suited to their work.

### *Handling Horses and Mules.*

Horses should never be overworked. In summer, in warm weather, they can be overcome by heat and if they do not die they are seldom fit for hard work again. During the summer, loads should always be made light when an extremely hot spell occurs. Even with lighter loads they should be allowed to rest some and should be frequently given water to drink. While they are drinking, it is generally possible to pour water over the horses' heads and necks, which is a great help to them. In the winter time

horses can likewise be overworked, although not as easily as in summer. Drawing extra heavy loads or covering a long distance every day without a let up will soon use a horse up and sometimes bring certain diseases. Strong, able horses and mules that are well animals are often made to do so much that they go blind. A totally blind horse is almost useless on a construction job. He can, however, be used in a four-horse plow team. Drivers can not decide when a horse should work and when not. Some man in authority should decide such matters.

During the winter months, great care should be given to the feet of horses and mules. The wet weather and mud are very hard on their legs and hoofs, and cause many diseases which prevent the animals from working. The stable should by all means be kept dry and each night the feet of the stock should be washed and dried. A good medicine chest should be kept for all their common ailments. Liniments, salves and other medicines should be obtained from some veterinary doctor and used according to his directions. To do this will mean the saving of a great many dollars every year.

The selection of a stable boss is always a difficult matter. For a small outfit of horses or mules, only one man is needed at the stable, but with large numbers of animals, several men will be necessary. The responsibility must fall on one man, whether he has a number of assistants or not. The stable boss should know much about horses and mules and be reliable and trustworthy. He must work from early morning until late in the evening. Sunday is a work day much like the others. It is difficult to obtain a good man for work which involves such responsibility, without paying a good salary, but few contractors seem to realize this and employ cheap men, with the result that their stock is not looked after properly. Remember that horses and mules are exactly like men. Good treatment, good housing and good food mean proficient work, while neglect means poor work. The difference between man and animal is that the first can protest, when he is wrongly used, while the latter cannot. His work, though, will deteriorate and the busy contractor will not be aware of the cause until the animal is either laid up or dead. Consequently, rigid inspections should be made of the stable and the stock at frequent intervals, and when the animals are not being treated properly, a prompt remedy should be given.

### *Buying and Selling Stock.*

No one can give instructions as to how to buy horses and mules. It is a matter of experience, and even experienced buyers are sometimes unsuccessful. But buying in large numbers, as a contractor must, is a different matter from buying a horse or two for one's personal use. For most purposes, young stock of the best kind should be purchased, and when any one animal begins to show signs of breaking or not being able to give a good day's work it should be sold. It is a good practice to have a price set on every animal or every pair of animals, so that if any one wishes to purchase there is a basis to make a sale. Many contractors keep stock too long. This is either from poor judgment in the matter or from sentiment, as most people become more or less attached to horses or mules that they own.

Sell horses and mules as they break, and if old animals cannot be used in carts or cars, then sell them off every year or two, while they will still bring a fair price. Some contractors by judicious buying and selling not only increase the number of their animals, but while they keep them up to a certain standard they make money from their buying and selling. All cannot do this, but those who do operate on the proper principles.

### *Renting Plant.*

As teams are rented or hired, so are the contractors' tools and machinery rented. As with teams, it is sometimes much cheaper for the contractor to rent than to own the machines or tools.

Small tools, wheelbarrows and such things, are rarely rented, and to rent such outfit seldom pays, except for a short time, such as a few days or a week or two. When scrapers, carts and wagons are rented, it is generally done in connection with horses, but not always. These, like plows, are rented by the day or week. Such things are not rented by dealers, as a rule, but by one contractor to another, or by team owners.

Much of the machinery and equipment that is rented is second handed, that is, it has been in use before, but in some cases new machines are rented. Some manufacturing companies sell or rent machinery, but the greater part of the renting business is handled by the numerous second-hand dealers.

In renting machines, the contractor pays the freight both ways, and is expected to keep the machines in repair, but is not responsible for the ordinary "wear and tear." For severe break downs on small machines, the owner is responsible when the break downs are not caused by negligence on the part of the contractor. This is especially true in cities, where the contractor can return the damaged machine and rent another from a different dealer. But with large machines, especially in the country, the contractor must himself make such repairs as are necessary or risk a delay in waiting for the owner. If it is uncertain who is to pay for the repairs, it is cheaper for the contractor to make them promptly and then take up the question of responsibility afterwards.

Some renting contracts are very specific concerning which party is to pay for repairs and keep the machines painted, even down to the owner's name painted on the machines. A definite contract is always a satisfactory one.

The basis of renting varies exceedingly. Some machines are never sold, but are rented, for an agreed price per unit of work. Thus when machines are not at work the contractor does not pay for them. The rental then is termed a "royalty," and payment is made on the engineer's estimate of work done.

Most renting is done on a time basis, by the pay, week or month. One unsatisfactory thing about the per diem rental is that it is difficult for the owner to keep a record of the days worked. For this reason the week or the month is the most common basis. Lost days are not taken into account. When machines are only to be used for a short time, a flat rental is sometimes named. This is another matter in which a definite contract prevents disputes.

When contracts can be finished in a short period of time, and a large amount of plant has to be purchased, it will be found that it is much cheaper to rent than to buy. Likewise, where a special machine is needed for a short time, rental is cheaper. Then, too, when machines are needed for short periods at different intervals, renting is advisable. At times, an expensive machine is needed for a job, but if the contractor cannot see that he will use it on another job, he may find it cheaper to rent than to buy, in spite of the fact that it may be worked continually, for he might have to sell it at a loss at the end of the job. In considering this, the interest on the investment as well as the depreciation must be

figured, and it may further be a detriment to the contractor to tie up so much of his capital. One advantage of renting is that although a heavy rate of interest is being paid, yet the contractor is working on another man's capital.

For continuous work and long jobs, it is cheaper and better to own the plant needed. It is the economic solution of the problem. There have been few figures published to show which is the cheaper, rented or owned plant. One eastern contractor doing considerable concrete work has made public some figures on concrete mixers. The data given is as follows:

*Plant Owned.*

| Mixer number | 2 | 3 | 4 | 6 | Totals and |
|---|---|---|---|---|---|
| Date Purchased | Aug 15, 1903. | June 10, 1904. | June 7, 1906. | June 5, 1907. | Aver |
| Original cost | $ 625.00 | $ 975 00 | $ 975.00 | $ 935 00 | $3,510.00 |
| Interest at 6% to Jan. 1, 1911 | 281.51 | 368.90 | 220.57 | 153.37 | 1,024.35 |
| Repairs to Jan. 1, 1911 | 941.87 | 350.29 | 216 43 | 437.01 | 1,945.60 |
| Total cost to Jan. 1, 1911 | 1,845.35 | 1,694.19 | 1,412.06 | 1,521.38 | 6,479.95 |
| Inventory value, Jan. 1, 1911 | 125.00 | 325 00 | 400 00 | 500 00 | 1,350.00 |
| Net cost, Jan. 1, 1911 | 1,723.38 | 1,369.10 | 1,012 00 | 1,025 38 | 5,129.95 |
| Total cubic yards mixed | 12,350 | 15,500 | 10,500 | 19,000 | 57,350 |
| Plant cost per cubic yard | 0.1395 | 0.0883 | 9.0964 | 0.0540 | 0.0894 |

*Plant on Rental Basis.*

| | | | | | |
|---|---|---|---|---|---|
| Days owned | 2,325 | 2,029 | 1,302 | 939 | 6,595 |
| Days rented | 837 | 768 | 816 | 536 | 2,997 |
| Per cent of days rented | 28.1 | 28.3 | 62 7 | 57.0 | 45.4 |
| Rental per day | $ 2.00 | 2 2.25 | $ 2.25 | $ 2 25 | ..... |
| Total rental | 1,655.00 | 1,616 25 | 1,835.25 | 1,204.50 | $6,311.00 |
| Plant cost per cubic yard | 0.1340 | 0.1042 | 0.1742 | 0.0634 | 0 11 |

*Comparison.*

| | | | | | |
|---|---|---|---|---|---|
| Plant cost owned | $0.1395 | $0.0833 | $0.0964 | $0.0540 | $0.0894 |
| Plant cost rented | 0.1340 | 0.1048 | 0.1748 | 0.0631 | 0.1100 |
| Per cent saved by owned | 4.1 | 15.25 | 44.8 | 14.7 | 18.72 |

It is doubtful if machines on a per diem basis could be rented at these rates. The prices given are evidently figured from rentals on a monthly basis and there is always some lost time. An analysis of these figures is of interest. The repair charges on old machines quickly become excessive; yet the general figures show a saving in owning the machines. These figures also give some data as to the

life of concrete mixers and the repairs and renewals on the revolving type of mixers. It would be interesting to know the makes of the four machines.

Construction jobs are sometimes held up for one reason and another, and the contractor is compelled to keep his plant on the job until the work is started again. Although some contracts provide that the contractor shall not be compensated for such delays, courts allow certain compensation, and especially for idle machines.

The basis of plant rental is from sixty to eighty per cent of the original cost of a machine, for one year. To obtain a monthly rate, this charge must be divided by that part of the year in which work could go on. This may seem to make a high monthly rate, but it is an equitable one, and the basis on which nearly all plant is rented.

*The Relations of Contractors and Manufacturers.*

Fifty years ago, tools used for construction work, especially in this country, were simple ones. For earth excavating, the pick, the shovel, the mattock, hoe and spade were about the only ones employed. A few wooden scrapers had been used, but these were the exception rather than the rule. Pile drivers were simple and crude affairs, either worked by hand or horse. The gin pole is as old as the pyramids; but derricks were formerly of light construction, operated by man or horse power. The ordinary tools were bought at the village store where a little of everything was supposed to be kept, but things needed were often not on hand. The few crude machines used were built by the contractor.

Dynamite was not known, and the only explosive used was black powder, which was of a poor quality. The railroads were afraid to transport it, and accordingly small powder mills were established wherever much powder had to be used.

Today all this has changed. We have powerful steam shovels, dredges, derricks and locomotive cranes, pile drivers of many kinds, locomotives and cars of large capacity, excavating buckets, concrete mixers, crushers, conveyors, drills, trench excavators and other machines too numerous to mention. There are also extensive plants manufacturing various kinds of material used in construction work, such as iron and steel, terra cotta, brick, cement and other products.

This change has brought into the construction field the engineering manufacturer. This term is used advisedly, since today the manufacturer is either an engineer, or the employer of an engineer or a large engineering corps. With him have appeared the manufacturers' agent, the supply man and the dealer in second-hand equipment, who are his field men. The proper recognition has never been accorded these important men in the contracting business, though in many ways both engineers and contractors are indebted to them.

The manufacturers and sales people are at times of great assistance to the contractor in the matter of extending credit. Large outfits are placed on jobs, either on easy payments or under lease agreements, and today it is possible to rent machinery instead of purchasing it. This means that the manufacturer has a considerable amount of money invested in plant which contractors are operating on their jobs. The manufacturer therefore has a vital interest in the success of the work.

The manufacturer's knowledge of machinery and the best methods of operation and of output is of great value to the contractor. Every day the sales agent and manufacturer are aiding the contractor through advice as to the handling of various undertakings. On the other hand, the contractor and the engineer also render valuable assistance to the manufacturer, in that they point out the needs of developing machines along certain lines to adapt them to new work or to give them a wider range. Thus, there is a construction fraternity having three closely related branches—the engineer, the contractor and the manufacturer of construction machinery and material. These three must work together to do most successfully the work in which they are interested in common. A national society forms their meeting-ground.

### *The Care of Plant.*

Contractors' plant needs constant care and attention. It should at all times be kept clean. Some machines, such as locomotives, steam shovels, concrete mixers and others, should be wiped up and cleaned every day, while once a week they should be gone over carefully and put in thorough order. Every man working on machines should understand when he is employed that he must keep them clean. Dirt in bearings quickly uses up machines.

Even small tools need attention. Tool boxes should be provided for each crew, and rules regarding tools should be placed inside each box. The tool house should be in charge of some competent man, who should see that the blacksmith keeps all tools in repair. Men do indifferent work with old and dilapidated tools. Good handles should be kept on all tools. Picks should be laid with new steel when necessary and kept sharp. Shovel handles and blades should be kept in good condition; bars should be kept straight and well pointed. Axes and other edge tools should be sharpened, and saws set and filed. The various kinds of hammers should be kept in shape; a good blacksmith should not have trouble in working them and giving them the proper temper.

Large machines should not only be kept in repair, but should be partially rebuilt from time to time.

Parts that are cracked or broken, especially gears, should be renewed, as one tooth stripped from a gear wheel may mean that, as the machine is being used to its greatest capacity, so many teeth may be stripped from the gears as to put it out of commission. This not only means expensive repairs, but time is lost on the work and men who receive monthly salaries are being paid, when productive work is not going on. In the same way, boiler fittings should all be kept in order and new grate bars put in the fire boxes. Burnt-out grate bars not only cause a considerable waste in coal, by half burnt coal dropping through the bars, but a decrease in steam, since the full value of the fuel is not obtained.

Old wood work on machines should be renewed. This is especially true of cars. How often one sees contractors' cars with the wood work all knocked to pieces, so that the cars operate with difficulty and part of the load is spilled before it reaches the dump. This also applies to carts. Scrapers should be repaired, especially the pans. Many will be found to need new cutting edges, and wheel scrapers may need new boxes in the wheels.

Special attention should be given to derricks and derrick fittings. After standing out in the weather unused all winter, derricks should be entirely overhauled, as the risk of killing men, working around them, is too great to assume. Piledrivers, too, should be well inspected, and repaired, wherever necessary. This applies to all the heavy machinery. Locomotives, likewise, need a complete overhauling. Ask any master mechanic of an operating railroad about the necessity of going over a locomotive at regular

intervals, and he will tell you of the importance of such work. One should not expect good work to be done when one's machinery is out of order. A loaded train must sometimes be divided because the locomotive needs a little shop work done on it.

All machinery should be painted each spring. Paint means protection both from rain and run. If metal is painted late in the season and exposed to the sun the paint is likely to blister, so all painting should be done early in the spring. Not only does paint make an outfit look a hundred per cent better, but it quickly pays for itself by preventing the metal parts from rusting and the wood from splitting.

A contractor's name should always be kept plain and bright on all of his outfit. This is just as important as names on railroad cars, since it shows the ownership at once and acts as an advertisement. In traveling on a train, when one passes a contractors' outfit at work, it is nearly always impossible to tell whose machinery it is, as the names have generally been effaced.

When outfit is idle contractors often leave it in the open without any kind of protection. This is certainly a great mistake, because the machine is sure to be injured by the snows and rains which occur during the winter. When a boiler, an engine or other machine is to be located at any point for a long time, it should have some kind of a temporary house built over and around it. This is not only a protection to the machine, but also means a saving of fuel. In addition, such a shelter is a protection to the operator and fireman and assists them in doing more efficient work.

Instead of leaving tools and machinery out in the open during the winter, advantage should be taken of this dull season to do any necessary repairing. Cars often need repairs both to the wood work and to the metal parts; other machines may need spare parts replaced, and nearly all machines should be repainted after a summer's use.

In the fall all small tools should be gathered, put in first class condition and placed in a shed or in boxes. A shed is preferable, since most tool boxes will leak, and the tools will become rusty quickly when they are not used each day. Other tools, which cannot be moved easily should have boards laid over them, or if this will not protect them properly, a shed should be built over them. If this is too expensive, they can be covered up with

canvas, and the tarpaulin properly secured against the wind. Canvas can also be used for curtains at the front of steam shovels, at the rear of locomotives and in similar places.

These precautions are all simple, and in most cases are inexpensive, yet they mean a great saving to a contractor, whether he intends to use the machines or tools again or intends to sell them.

### *Lack of Plant.*

Many contractors do not place sufficient plant on their jobs to do the work economically. In some cases this is so for want of capital, but when plant can be rented, or purchased on a lease sale, this defect should be overcome. Work is always made more expensive by a lack of plant. In Chapter VIII, under the heading Mismanagement of Work, some examples of the lack of plant are given.

### *Excessive Plant.*

However much the lack of plant shows bad management, excessive plant is really worse. The loss of money by it is more difficult to ascertain. The plant may not only be excessive, but it may at the same time be poorly devised, and so cumbersome as to do but little work. Not only is the cost of running increased by the excessive plant, but much of the capital is tied up in the investment, and it is not only not earning interest, but not making any money to cover depreciation. Several jobs run with excessive plant would soon send the ordinary contractor into bankruptcy.

# CHAPTER X.

## A PERSONAL CHAPTER FOR THE CONTRACTOR.

INDUSTRIAL indemnity is a many-sided subject, and a very important one to both employer and employee. Within the past ten years, business men have given much thought not only to the way injured workmen should be compensated, but how to prevent industrial accidents.

### *Preventing Accidents.*

Contractors who operate much machinery should see to it that all parts, such as gears, wheels and cranks are well protected with metal guards. Such guards prevent some dust and dirt from getting into parts of the machinery that play or bear on one another, preventing the grit from wearing out or otherwise injuring the machinery. Oil cups should have caps on them for the same reason. Nothing is worse than to have dirt carried into the delicate parts of a machine through the oil cups or lubricators, yet on contract work this is so often permitted. Caps of cups and lubricators are laid down and are frequently covered up with dirt so they cannot be found. If new caps cannot be produced at once, plugs made of packing or wood should be used until the regular style of caps can be ordered.

But another reason, and a most important one, why all parts of machinery should be guarded, is the danger of injuring or killing men. An injured man can recover from the contractor for an accident from a gear wheel which could be properly guarded. Only a few years ago a contractor was sued by a shovel runner who was caught in some unprotected gear wheel on a shovel and was severely injured. The courts awarded the injured man several thousand dollars.

Insist on all machinery having the proper guards when it is purchased. If they are not provided, it is generally advisable to have such guards placed, even if done at an extra cost.

In addition to guards on gears, conspicuous signs should also

be used on construction work, not only to keep out the general public, but to warn the men to keep out of places where they have no business, and to prohibit them from getting on cars, locomotives and similar machines. A sign telling the men not to ride on a locomotive saved a contractor from paying heavy damages for the death of a man who disobeyed the instructions. The author once had a young boy severely injured in riding on a small 1½-yard dump car when he was forbidden to do so. A sign board on each car would have been of great benefit in a case like this. However, the boy could not recover damages on account of a large number of witnesses, who destified to the fact that the boy was warned frequently and ordered not to ride on the cars.

Too much care and forethought cannot be given to these subjects by contractors and their superintendents. Injuries and deaths are thus prevented, and if accidents do happen, the contractor is clear of any legal responsibility.

In towns and cities, on large jobs or very dangerous ones, fences should be built to keep out the public, and signs should be posted. Sometimes it is also necessary to employ a watchman or guard to prevent curious people from entering the enclosure. At night, lanterns with red globes should be displayed in conspicuous places. When these precautions mean additional expense they should be figured in the prices bid on the work.

Do everything possible to prevent accidents, as it means security to life and limb and money saved to the contractor. The mere fact that precautions are taken to prevent accidents is an asset and advertisement to the one who takes them, and may mean that workmen can be easily obtained. One large manufacturing company in this country displays on all of its factories signs that can be read both during the day and night to the effect that all machines have the proper guards and protection on them, and that men in their employ are requested to report all machines that are out of order. This makes it easier to obtain employees.

### *Employers' Liability.*

But as accidents will come, it is well for the ordinary employer to protect himself against loss in this connection by liability insurance. Every contractor should understand the general principles of casualty insurance. In the ordinary employers' liability

insurance, the company agrees to indemnify the contractor against loss within the limits of the policy and the limits set by law. The ordinary policy is written with a $5,000 and $10,000 limit. That is, in case of an accident the insurance company will not pay more than $5,000 to one person, nor more than $10,000 for one accident in which more than one person is injured. Amount in excess of these figures can be obtained by paying an increased premium.

The premiums are based on the amount of pay roll and the different classes of work to be done. Before the policy is taken out, an estimate is made of the probable pay roll on the job and the rates named in the policy are based upon this. These rates vary from about one to ten per cent, seldom, though, going over six or seven per cent, and generally ranging from one and one-half to three per cent. A low rate is named for common laborers making ordinary earth excavation, while a much higher rate is paid for men making rock excavation, where explosives are used. Greater premiums must be paid for men doing tunnel work, for structural steel workers and for men working under compressed air. Many classifications are made by the insurance company, each having a different rate. All of these classifications are covered by one policy. Accordingly, the pay rolls should be divided so that each rate can be easily applied.

The insurance company under the terms of the contract have the right, for their own protection, to audit the pay rolls of the contractor, if they wish, monthly, in order to obtain the figures for adjusting the amount of the premium. This is necessary. The original premium is based on a mere estimate, but it must be accurately calculated for final settlement. Consequently, the auditors of the company must obtain the required information from the pay rolls of the contractors, and if the pay rolls are incomplete, then the company has the right to audit the books of the contractor. For other classes of insurance to be named later, it is also necessary to inspect pay rolls and books; but many contractors, through ignorance, refuse to let the company exercise their rights. To some extent, this is the fault of the brokers who obtain the business without explaining the matter to their customers.

The minimum premium paid on any policy is $50 per annum. The policy can be written for a certain job, whether it runs a year or not, or it can be written for work done over a term of years in

one locality, whether the work is done under one or more contracts. A policy does not protect the contractor if he employs any one illegally—as a minor, under the age prescribed by the child labor laws.

There is one feature of liability insurance that is seemingly an injustice to contractors. To illustrate: The rate of insurance quoted for certain grading work, say, is $1.60 per hundred dollars of pay roll. The job, being a new one, starts up in the spring of the year. The contractor employs, say 100 men. The rate of wages is $1.50 per day of 10 hours. Within a few months additional work is let in that locality, making laborers scarce, and the contractor is compelled to pay $1.75 per day. Towards the end of the season men are more difficult to obtain, and wages have to be raised to $2.00 per day. However, the contractor continues to work just 100 men. Now see the result. Although the number of men worked remains the same, so that the chance of accident is not increased, yet the amount of his premium is first increased 16 2-3 per cent, and finally 33 1-3, a considerable item.

Without any more protection the contractor must increase his premium, the insurance company deriving the benefit from their client's misfortune, and adding to his expenses, which have already been greatly increased.

The insurance company's defense of this position is that the larger a man's wages are, the more he can recover in case of accident. This is partly so. There is little doubt that a foreman receiving five dollars per day can recover a larger amount than a common laborer, for he is considered in a different class; but increasing a common laborer's wages by twenty-five or fifty cents per day will not add to the damages he can recover in case of injury or death. The author has had an extensive experience in these matters in various sections of the country, and has found this to be the case, nor has he ever seen any statistics that would disprove it.

The remedy should be an easy one. The premium rate named could be based on rates of wages listed in the policy, and if any increase occurred in the wages, such increase could be ignored in adjusting the premium. Or the rate could be based simply on the number of men employed. This would be fair to both parties. There is little doubt that the prevailing class of insurance has been profitable to those companies engaged in writing it,

so that they could afford to make a concession of this character to their customers. However, if they are like some of the insurance companies, they will never consider such a suggestion until they are compelled to do so by law.

### *Public Liability.*

The public is covered by a separate policy, for which a special rate is paid, although not as high as that paid for employees' liability. It is also possible to cover public liability in the same policy as the employees'.

### *Team Insurance.*

For the team work, accident to driver and the public can be covered in the regular policy, but the insuring of the teams is generally a special item. There are companies that will insure the horses against accident or being stolen, and even against sickness. Special policies can also be obtained covering damage to property by horses.

### *Automobile Liability.*

Other liability insurance may be had for automobiles used by the contractors and their superintendents and for the auto-truck used for hauling. Now that contractors are using these vehicles, these items should not be overlooked.

In building work, contractors' hoists for elevating materials can be covered by a policy, and as accidents frequently occur with these, it is advisable to cover them.

### *Contingent Policies.*

Owners for buildings can take out contingent policies covering accidents that the contractor may have with his men, and also for bills for materials that are not paid. Owners are thus protected from loss.

### *Merits of Liability Insurance.*

The labor question is a prominent one today, and politicians are learning that the labor vote must be given much consideration. Hence, we find that our public officials, politicians and statesmen are interested in employer's liability, and thus the subject has be-

come a popular one. This is evidenced by the fact that the states of New York, Massachusetts, New Jersey, Wisconsin, Minnesota, Ohio and Illinois have appointed commissioners to study the subject of compensation to workmen for injuries received in industrial accidents. It is thought that Michigan, Oregon and Missouri will do likewise in the near future.

There is little doubt that great injustices occur on both sides, and especially are the workmen wronged. A report from the Minnesota commission shows that, in the cases investigated, fifty per cent of the families of men killed in industrial accidents received no compensation; twenty-four per cent received less than two thousand dollars; only eleven per cent received more than that sum. In five cases of permanent total disability one man got $160, one got $175, and three got nothing. Those who fared best were the ones injured seriously but not permanently; that is, the ones left least helpless. This principle of compensation is clearly wrong, but it has been brought about in an unfortunate manner.

In the early days there were no insurance companies to come between the employer and employee. Few machines were used in any line of business, and those used were simple in construction and mostly operated by hand power. Most men were employed by an individual or firm, there being few large corporations. Accidents seldom occurred, and when they did happen, the employer made some provision for the injured man, or for the family of the man who was killed.

When machines of all kinds began to be used in all lines of manufacturing and construction work, accidents became more frequent. Employers found it a great strain on their resources and an impediment to their business to be paying out sums of money for accidents frequently caused by carelessness of their men, and therefore refused to pay any indemnity for accidents. Then employees sued. No special laws covered the subjects and suits were brought and defended under the old English common law. The two stock defenses which grew out of this condition of affairs were the fellow servant act and the assumption of the risk of the employment. Thus the employer could not be held responsible for the negligence or carelessness of an employee who injured a fellow workman, and the laborer taking employment to operate a dangerous machine, assumed the risk of being hurt. These have become well known principles of our law.

Attempts have been made by legislation to change these; but few laws have been enacted, for a law would affect all employers alike, and the employer, frequently a legislator, has been unwilling to make himself liable. Some years ago in one of our southern states, the legislature was considering a law to do away with the fellow-servant act. A brilliant railroad attorney appeared before the committee having the bill in charge. He stated that he would not oppose the law, if it was made to apply to all employers of labor and not to railroads and manufacturers alone. He said the railroads would accept their responsibility for accidents to one servant caused by another, but the farmer too must accept the risk of sending a driver into a field to haul vegetables, with a helper to assist in loading, and if the driver drove into a ditch, upsetting the wagon, and killing the helper, the farmer, too, must be responsible. It is needless to say the bill was not reported favorably from the committee, which was made up mostly of farmers.

With numerous lawsuits occurring between employee and employer, the opportunity of making a business of this arose, and we find insurance companies taking the risk of a suit at law for a consideration. Thus arose the employers' liability insurance, which filled a long-felt need, and which still possesses merit, especially for the contractor. The next step was the formation of an insurance company to fight the employer for the employees, but the latter did not insure, so the company soon went out of business.

The entire matter is a personal and selfish one. The employer does not want to pay out large sums of money with no returns, especially when he feels he is not directly to blame. The workman, on the other hand, has to suffer physical pain, pay doctors' bills, sustain the loss of his wages, and is sometimes crippled for life. He feels that he should be compensated for these things. The honest, conscientious employer feels that when a good workman who has been in his employ for some years is injured, the man should be cared for and paid for his lost time, but the employer also knows that if he does this, a careless, good-for-nothing fellow who is injured will expect and demand the same thing. Consequently, as soon as a man is hurt the employer is on the defensive.

The insurance company safeguards the employer in that it will settle small claims, and sometimes large ones, without a lawsuit, but the company must make money, and usually finds it ad-

vantageous to fight most of the large claims. This deters many from bringing suit.

But lawsuits are entered, and industrial accidents have been a prolific source of income to the lawyers, and have filled our civil courts with business. Enough money is wasted in litigation over damage claims to provide considerable compensation for the victims of accidents. Employers and taxpayers contribute millions to this account, but the courts, lawyers and insurance companies get most of the money. Large employers of labor are beginning to realize that these conditions are not healthy ones, and that the method of fighting all personal injury claims is not economical. Thus in any hazardous industry, the indemnities paid in cases lost, added to the legal cost of all the cases defended, whether won or lost, makes a total which may easily be, and generally is, greater than would be incurred in fair and prompt payment direct to the men upon a reasonable and systematic plan. The direct payment also gives the injured man his due, and he gets it quickly when he needs it most, and he does not have to give the major portion to a lawyer.

*Workmen's Compensation Insurance.*

This opens up the subject of workmen's compensation insurance, which is the term used for covering the provision of state laws, that compels certain compensation for injuries or death to workmen. The rates for this are high; in some cases as much as seven per cent of the pay roll. The family of the man in case of injury or death is not paid money over a term of years; but the company attempts to settle by a lump sum payment.

The development of workmen's compensation for injury or death has just commenced, and a few years will work many changes. The laboring man is to be treated better in this respect, as the sentiment is fast growing that the industry must care for those who meet with accidents.

Some of the largest manufacturing companies, realizing these facts, and learning that the insurance companies no longer serve their purpose, have adopted methods of their own to compensate their employees.

The International Harvester Company of America has inaugurated a system of indemnifying its employees in all its plants for injuries sustained while at their work. They state:

"During the year the company put into operation a comprehensive plan for compensating its employees for injuries resulting from industrial accidents. This plan is based upon the principle that the industry should bear the burden of industrial accidents and that compensation should be paid promptly to all injured employees, or in case of death to their dependents, according to a fixed scale, regardless of legal liability. The company has thus been a pioneer in attempting to solve the difficult problem of avoiding the waste, delays, injustices and antagonisms incident to personal-injury litigation."

The Edison Company of New York is likewise dealing directly with its men. Some of this company's methods are quite original. In one case a man was killed in one of its plants. He was buried at the company's expense. Then a grocery store near the plant was bought and stocked with goods, and was made over to the man's widow with sufficient funds so that she could earn a living for herself and children. Notices were posted in the plant telling the employees what had been done and asking that their trade be given the widow, since the company was interested in her welfare. This was far better than paying her a lump sum, which would no doubt have been lost in unprofitable investments.

The United States Steel Corporation has made an extensive study of the entire subject. First a body of experts was employed to assist in preventing accidents. They decided on the best method of safeguarding all dangerous machinery. The men were instructed as to the safest methods of doing their work. Prizes were offered to the men for suggestions along these lines. Nothing could be more important than this. It is easier and cheaper to prevent accidents than to pay for them. While this work was going on, the corporation was working out a method for compensating its employees for injuries, both temporary and permanent, and for providing for their families in case of death. A statement of the plan now used is given by Mr. E. H. Gary, chairman of the board.

"During temporary disablement single men receive 35 per cent of their wages, and married men 50 per cent, with an additional 5 per cent for each child under 16, and 2 per cent for each year of service above five years. For permanent injuries, lump payments are provided. In case men are killed in work accidents, their widows and children will receive one and a half years' wages,

with an additional 10 per cent for each child under 16, and 3 per cent for each year of service for the decedent above five years.

"For some years the subsidiary companies of the United States Steel Corporation have been making payments to men injured and to families of men killed, in practically all cases without regard to legal liability. These payments have amounted to more than $1,000,000 a year, but it is believed that the plan now adopted will result in additional benefits. Experience perhaps will lead to some modifications of this plan."

In addition to this, the steel corporation pensions its old employees. Andrew Carnegie established a pension fund of $4,000,000, and lately the corporation has set aside from six to eight million dollars, thus making a total pension fund of from ten to twelve million dollars. This fund, properly handled, should increase and provide handsomely for the old employees.

Many of the railroad companies also provide for payment to their employees in case of accidents. One company which has done this for years is the Baltimore & Ohio. This road has a relief department or association. A corps of physicians is maintained, and men are examined when they are employed, just as is done by a life insurance company, since sick benefits are paid as well as accident benefits. Weak and sickly men are not wanted. Benefits are paid men in case of injury, or to their families in case of death, whether the company is legally responsible or not. Each employee pays into the relief department a monthly premium.

In most cases the contract business hardly admits of the adoption of these systems. However, in several states laws have been passed giving certain compensation to injured workmen and materially changing the old laws governing the gaining of damages. Some provisions of the New York law are given, showing that it applies to workmen engaged as follows:

"1. The erection or demolition of any bridge or building in which there is, or in which the plans and specifications require, iron or steel framework.

"2. The operation of elevators, elevating machines or derricks or hoisting apparatus used within or on the outside of any bridge or building for the conveying of materials in connection with the erection or demolition of such bridge or building.

"3. Work on scaffolds of any kind elevated twenty feet or more above the ground, water or floor beneath, in the erection,

construction, painting, alteration or repair of buildings, bridges or structures.

"4. Construction, operation, alteration or repair of wires, cables, switchboards or apparatus charged with electric currents.

"5. All work necessitating dangerous proximity to gunpowder, blasting powder, dynamite or other explosives, where the same are used as instrumentalities of the industry.

"6. The operation on steam roads of locomotives, engines, trains, motors or cars propelled by gravity or steam, electricity or other mechanical power, or the construction or repair of steam road tracks and roadbeds over which such locomotives, engines, trains, motors or cars are operated.

"7. The construction of tunnels and subways.

"8. All work carried on under compressed air."

All of these provisions apply to contracting, besides covering other classes of work; so under nearly every circumstance the contractor is liable.

Under the head of "Basis of Liability" the law provides:

"If, in the course of any of the employments above described, personal injury by accident arising out of and in the course of the employment after this article takes effect, is caused to any workman employed therein, in whole or in part, or the damage or injury caused thereby is in whole or part contributed to by (a) a necessary risk or danger of the employment or one inherent in the nature thereof; or (b) failure of the employer of such workman or any of his or its officers, agents or employees to exercise due care, or to comply with any law affecting such employment; then such employer shall be liable to pay compensation."

The law also sets forth that should a contractor sublet to another contractor all or a part of his work, then the original contractor is liable, the same as though he did the work himself. The burden of proof is also placed on the employer.

Part of this law affecting the compensation of workmen has been declared unconstitutional; but another law will no doubt take its place—at least, the insurance companies anticipate such legislation.

Such a law affecting a manufacturer might not be bad, as the manufacturer has all of his machines continually in the same place and to a great extent can control them. Safety devices and proper protection can be installed and readily maintained. His men are

in his employ for years. Young men are taken into the shops as apprentices and are trained to work around certain machinery, which they get to know well.

With the contractor this is all different. He moves from one section of the country to another. Many accidents are the result of the continual moving of heavy machinery, and the contractor having several jobs must rely on hired men to superintend these things. Men are seldom in his employ for more than a few months at a time. As soon as a job is completed he is compelled to discharge his forces. The class of labor he is forced to employ is of the poorest character, and even his high-priced men are often given to heavy drinking, although they may not be drunk while at work. It is difficult for the contractor to work out any plan of caring for his injured workmen, except on a few jobs which may last over a term of several years. Yet this law throws all responsibility on the contractor. This is wrong, and will work injustice.

Take for instance the handling of explosives. An ordinary blaster knows little of the nature of the explosives he handles. He is told not to thaw dynamite by an open fire or with hot water; the contractor even furnishes him with a thawing kettle. But this type of man, feeling that he knows all, will not listen to advice or obey instructions, and when in a hurry, puts his thawing kettle aside and thaws dynamite by an open fire, with the result that an accident occurs and he and several fellow workmen are killed. The contractor should not be liable for such behavior.

Another characteristic of contractors' employees, is that few of them will protest or inform their employers of rules or instructions ignored. They thus assume the risk of the negligence of their fellow servants.

This law will allow workmen to injure themselves slightly, in order to draw pay without doing work. The contractor will then be compelled to pay what will in many cases be little more than blackmail. There is injustice also in making an owner responsible for accidents of a contractor, or a contractor liable for accidents of one of his sub-contractors.

The law discriminates, since the farmer will not be liable in case one servant injures another, nor for a man who injures himself with a threshing machine. He is still able to use as a defence the fellow servant act, and the assumption of risk when the laborer takes employment. Under the new law the contractor can no

longer use these defenses. The workman may have needed some more favorable legislation than he had, but this law has gone to the other extreme.

*Accepting Responsibility.*

Whenever a contractor has liability insurance of any kind, and an accident occurs, he must not in any manner accept responsibility. He should render first aid and see that proper medical attention is given. Beyond this the company will not allow the contractor to go. In case of a severe accident, telegraph the insurance company, so that it can decide what to do.

In any book of rules that a contractor issues, instructions should be given as to what is necessary in case of accident, and the information should be added that the contractor does not assume responsibility. For minor accidents, the contractor is often in a position to settle with his men; but if he attempts to do so, without first receiving instructions from the insurance company, he is assuming responsibility, and at once the company can repudiate the entire settlement. If the insurance is worth having, the contractor should abide by the terms of the policy.

*Insurance.*

A contractor should avail himself of insurance whenever possible. Fire insurance for certain things such as office furniture in the country, commissary goods, tools and goods stored in warehouses, and even for some machinery, is a great safeguard. Men are careless and a fire on construction work means considerable loss. Insurance rates are high in the country, but the loss by fire amounts to much more. Dredges, pile drivers and such equipment should not only be covered with fire insurance, but also with marine insurance, for such machines are not only often destroyed to the water line by fires, but are sometimes wrecked by storms.

Partnership insurance is also advisable. Each partner or director of a closed corporation insures his life in favor of the others. When important and profitable contracts, or those that take a number of years to complete, are under way, and a member of the company dies, through the aid of the insurance money the work can go on, even if the capital the deceased member had in the company is withdrawn. In an incorporated company this can be

done without insurance, by selling the interest involved; but that is not always possible. Only recently a contracting corporation had many millions of dollars worth of work under way. Their capitalization was small, but one member of the firm was a very wealthy man. Through him the company was about to borrow a large sum of money that was needed to carry out their contracts. Just as the loan was being consummated this man died and the financial condition of the company was such that the creditors were compelled to take over their work. By the arrangements made, the large profits that would have accrued to the contractors went to the creditors. If this man had taken out a large partnership insurance his death would not have been such a financial loss to his associates.

Every contractor, engaged as he is in an uncertain profession, should have his life insured in favor of his family and heirs.

### *Bonding Employees.*

Employees handling money and accounts should be bonded in some surety company. A contractor is compelled to give bond to those who employ him, yet he seldom makes his responsible employees furnish bond to him. There are many cases of theft in time keeping, making out pay rolls, purchasing camp supplies, handling commissary goods, and even in purchasing materials and plant. A bond not only protects the contractor against petty losses in these things, but it makes new employees furnish references as to their character, and when they are bonded by a surety company the latter will to some extent see that those who are bonded are leading lives where they are not subjected to such great temptations as gambling and excessive drinking.

### *Diaries.*

Keeping diaries is an actual necessity on contract work. A diary should be kept in the branch office of each construction camp and also in the main office. Some one man should be appointed to keep up each diary, but the leading officials should always make entries of important incidents and of various troubles and accidents that occur. Thus two men may write of the same things so that one corroborates the other and all the points are

covered. Diaries can be very important things in a lawsuit and when several people have covered the same incident, the diaries carry more weight in court and they are excellent for refreshing every one's memory.

The weather should always be recorded in the diary. Not only the temperature, but as to whether it was cloudy, rainy or fair. Snowstorms and severe windstorms should be recorded, and if possible the rainfall should be measured and set down.

The dates of important letters received or sent bearing on the contract should be mentioned. Plans received and also bills of materials from engineers should be recorded. The dates should also be stamped on them with a rubber stamp. The comings and goings of the leading officials and engineers should be set down each day, and also conversations that occur regarding the work. The names of witnesses to these convervations should be kept. Orders received verbally should be entered in the diaries, as such orders frequently cause trouble, and for them to be written down by the contractor on the day received means a protection to the contractor.

Records of work done, especially where the payment may be in dispute, as for extra work, should be recorded in the diary in addition to the usual place of keeping such records. Records of days when pumping was necessary in deep foundations and similar work may be valuable in the diary.

Diaries should always be kept secret. Unresponsible employees should not be allowed to see them, as they may furnish the information they contain to others, and the matters are likely to become camp talk.

### *Legal Advice.*

Lawyers are expensive, but their services are of great value to a contractor. Every man engaged in contracting should always retain an able lawyer to advise him. In addition, a lawyer should be retained in each state in which a contractor has work. Laws vary much in the different states, and few lawyers practice outside of their own states, except in the United States courts. When a piece of work is started in a new locality, one of the first things to do is to employ a lawyer living in that section. He will know the people there and the contractor will thus introduce himself favorably to the people among whom he has to work. The attorney will

be able to get from officials and the public many favors that the contractor could not obtain himself. He has counsel to defend him in small suits that are bound to occur, and in many cases such suits will never come to trial through the efforts of a competent local attorney.

A contractor's chief counsel can also prevent many injustices for his employer. When trouble does occur, instead of waiting until the contractor has suffered a great loss, the attorney will so handle his affairs that the contractor will not waive his rights, or make such errors as will cause him to lose a lawsuit, if one occurs, before it comes to trial. In fact, a good attorney can so handle breaches of contracts, claims for extra work and similar things that the cases are nominally won before suits at law are brought. The author has seen such things and writes from experience. It is likewise advisable to engage an expert engineer as trouble occurs, instead of when the suit is to be tried. His work in connection with the attorney's may mean much money saved to the contractors.

A lawyer's advice as to what contracts to sign and what not to sign may mean not only prevention against obtaining unprofitable contracts, but also those under which the contractor may sign away his property.

### *Photography.*

Some contractors realize the value of photography in connection with contracting, while others seem to think it is only a luxury. Photographs on construction work can be taken for three purposes.

1. For recording the progress of the work or showing details of construction methods, designs and other features.
2. Photographs to be used in litigation or to prevent lawsuits.
3. Photographs for advertising purposes.

Some contractors who have photographs taken regularly, employ a man to travel from job to job, while others have a man on each job. It is well that the man should know something of construction work and that he should be an accomplished photographer so that if his work is carried into court discredit cannot be thrown on it.

Rules should be laid down for taking photographs, so that there will be uniformity in this work, no matter who takes them. A size of photographs much used is 8x10 inches. They are seldom mounted on cards, and for some purposes only blue prints are made, but most construction photographs are mounted on linen or muslin with a small margin left on one side, so that they can be placed in a lose leaf binder. All photographs should be dated on the plates, a number put on them, name of contract, and some letter or symbol to denote from what point they were taken. It is also advisable to put on them the name or initials of the photographer. With all of this information on the plate, it will be printed on each photograph.

*Photographs to Show Progress.*

For this purpose, points should be established from which to take the photographs. If the job is small and covers a limited area, only one such place may be needed, but for large jobs a number of points must be selected, and the direction for pointing the camera indicated. For buildings and tall structures, it is sometimes necessary to build elevated platforms for this purpose. On railroad jobs many points must be selected and they should be marked so as to be readily found again.

The photographs should be taken at regular intervals. Weekly or semi-monthly seem to be the most favorite times. Special photographs of details of the work must be taken between times and from special points. Damage done by storms should also be recorded by the camera.

Progress reports to the main office should be accompanied by photographs. In some ways they tell a more graphic story than the reports themselves, and it is difficult to doctor a photograph, while it is easy to do it to reports.

Photographs should be taken showing the improved methods of doing work, well designed braces, forms and other things that have been improvised in the field. These, with plans made afterwards, will be found valuable on other jobs.

*Photographs for Lawsuits.*

When photographs are to be used in court, they are not accepted as evidence until the photographer identifies them, testify-

ing as to the date on which they were taken and the place and other details. He may be able to testify as to what he meant to show by them, but as a rule the pictures must show such things themselves.

Not only can evidence be submitted by photographs concerning work done, progress made, faulty plans and construction, classification of work and materials, effects of storms, unstable foundations, and bad leaks in cofferdams, but concerning conditions of adjoining property and extent of damage done to them.

Photographs can be taken of machinery broken in transit so as to collect damages from the transportation companies. Likewise by photographs, checks can be kept on subcontractors so as to prevent them from making unjust claims.

### *Photographs for Advertising.*

Not only can photographs of construction work be taken to be reproduced in advertising in papers, but for many other purposes that help to advertise the contractor and obtain new jobs. Photographs made into albums can be used to show prospective customers the variety and character of the work done by the contractor. Such photographs should be taken with a different object in view from progress pictures. They should show the character of the construction and the plant employed. Signs showing the contractor's name should be displayed.

Another means of advertising is to take photographs of machines and equipment with the contractor's name displayed, and send them to the makers or manufacturers who will reproduce them to advertise their own business and thus advertise the contractor. Photographs of work reproduced in trade or technical papers in connection with articles descriptive of work done by contractors is another means of advertising.

### *Advertising.*

Few contractors do much advertising of their business. Until recently there seemed to be a prejudice against their advertising in the technical journals, and anyone who advertised was looked down upon by his fellow contractors. This prejudice, however, has disappeared and a large number of contractors are now ad-

vertisers. Some use the technical and trade papers, others advertise in the daily papers of the cities in which they have offices. Few of them do more than show a photograph of work done and display a card. If the money is to be spent, the best results possible should be desired, and these may be obtained by changing the advertisements frequently and telling something in the space regarding the work done by the contractor. Any specialty done, speed, form of contract, quality of work and testimonial letters from customers may prove effective.

Pamphlets and circulars can be issued by contractors and used as a manufacturer does a catalogue. There can be little doubt that contractors can increase their business by advertising and everyone should give this subject careful consideration.

### *Catalogues.*

Trade catalogues are valuable to contractors, but unfortunately the number of them is so great that it is difficult to file them for ready reference. Then, too, the sizes and shapes differ so much as to add to the trouble of preserving them. The majority of catalogues contain much valuable information that in many cases cannot be duplicated elsewhere, and are also of service in buying new machines or in ordering parts for repair work. Many contractors do not keep catalogues, as they can obtain those covering any subject by mailing the manufacturers a request. Others keep a few that cover the special machines they use most, and destroy the rest. A few contractors keep extensive catalogue files. In New York City there is a large library of trade catalogues maintained. Visitors are welcomed to the rooms.

Catalogues could be filed easier if they were all the same size and shape, but each manufacturer's identity would be destroyed by this, and as his catalogue is an attempt to carry himself to his customers, he wants a catalogue that will distinguish him from his competitors.

### *Technical and Trade Papers.*

There is not a trade or profession that has not its trade papers and journals. Contractors are fortunate in this respect as there are a number of engineering papers in the country and also jour-

nals devoted entirely to the profession of contracting. Such papers are invaluable to contractors. They can keep posted as to new methods devised, and new machines and tools. They can also obtain description of important jobs under way. News of jobs to be let are also given in these journals, and by reading them contractors can keep posted as to new work. Then the advertising pages may be used by contractors to obtain catalogues and purchase new plant. As much machinery is bought through agents, it is difficult to trace sales made to the advertisements; but contractors often read the advertising pages of a paper when they do not read the paper itself.

# ADDENDA

## CHANGING PLANS AFTER CONTRACT IS AWARDED.

EVERY contract for construction work has in it a clause reserving to the owner's engineer the right and privilege to make changes in the work during the progress of construction. In nearly every case some few changes are made, but as a rule they are of minor importance, and harm is done to no one. Yet this right of changing the work can become a most serious matter to a contractor. Rather than discuss the subject from a hypothetical standpoint the following examples are given to call the attention of both engineers and contractors to abuses of such clauses.

Some years ago, two brothers were carrying on a business of contracting in the state of Washington. They had made money for several years, after which they succeeded in obtaining the best contract, in their opinion, that they had ever had. It was for about a hundred miles of railroad construction, located in the mountains. For many miles the line ran along the side of the mountain, giving very desirable and heavy rock excavation and a large amount of masonry work. There were a number of tunnels. The contractors built camps and bought compressor plants, drills, derricks, cars and other machinery suitable to the job. They expended their entire capital in purchasing and installing an up-to-date plant. But little work was done when orders were received to suspend operation. The line was relocated over most of its length and thrown down into the valley. The outfit purchased was not suited to the new work, which called for scrapers only, and little of the masonry was needed.

The contractors had spent their money and could not raise additional capital to purchase new outfit quickly enough to cover the work. Their contract was declared forfeited and they became bankrupt. They brought suit against the railroad company, but could not recover, owing to the clause in the contract that gave

the engineer the right to change the alignment, grades, etc., as he saw fit. This was the case where most of the line was changed, but contractors can also suffer greatly from small and frequent changes being made.

Only a few years ago the author made a report for some contractors on such changes made by the engineer of the railroad company for which they were working. Two contracting firms had taken the work together. Extracts from the report tell the story.

Proposals in competition with other contractors were submitted on the work, and the firms in question secured the job. In addition to the contract and specifications setting forth the job, the contract stated: "This work is more fully described and set forth in the plans prepared for the same and filed in the chief engineer's office. First: map of section, B (the section in question), mile-post 123 to mile-post 145; second, profile of section B, mile-post 123 to mile-post 145; third, various details of masonry, trestles, etc.; and in the specifications hereto annexed, and which plans and specifications are hereby declared to be and are accepted as an essential part of this agreement."

A close study of the form and provisions of this contract and these specifications showed that they were exceedingly stringent. There were many clauses that worked hardship upon the contractors and gave no corresponding benefit to the railway company. Many other clauses were unreasonable and arbitrary in their provisions. The contract was a wordy one; the sentences and phrases were so put together as to be most confusing and to necessitate reading and re-reading to obtain the meaning of some of its provisions.

Many stipulations of the contract were unusual, as it threw all responsibility of whatever character on the contractor, whether of rains or storms; mistakes and insufficient plans and drawings of the engineers; of taking care of materials and roadbed; of staking out the work correctly; all damages to the railroad and its structures; and all similar risks.

The contract was dated in the month of December, but stipulated that work should commence on May 1 of the following year, and should be completed by December of that year. It was thus evident that but little of the work was expected to be done during the winter months. This had an important bearing on the work. The material to be excavated was mostly earth, but little rock being

found, and this mostly in the bottom of the deepest cuts. The earth consisted mostly of red and blue clay, the latter underlying the former.

The profile, which was stated to be an essential part of the contract, was made up in great detail, showing all quantities, cuts and embankments, the wastes and borrows, and showing hauls and overhauls, many items being set forth in detail, and the aggregate quantity of the work to be done on each mile was also listed.

At some points it was indicated that there was not enough material in the adjacent cuts to make some of the larger embankments, thus showing on the profile that borrow pits were to be opened up and the needed material obtained from them. Other cuts showed that there was waste to be made, under clauses in the specifications that provided for this.

In submitting proposals, contractors were asked to name a price for team work, on which there was to be a free haul and overhaul, and also on steam shovel work with a haul not exceeding two miles, and also on steam shovel work with a haul not exceeding three miles. This was done.

On the entire 22 miles of work, the profile showed only one cut that contained more than 90,000 cubic yards of material. It was believed from the nature of the ground in that locality that this cut would contain some rock. Overhaul on this large amount of material was not shown on the profile, nor was there any indication that any of this material was to be wasted. East of the cut there was a large embankment, but the profile did not call for any borrow. The extreme haul from the cut to this embankment was greater than the extreme haul for teams named in the specifications, consequently the contractors believed that this cut was meant to be taken out with a steam shovel. This belief was verified verbally in conversations with the engineers. The contractors were men of experience, and from their study of the work on the ground and on the profile, they knew that the rest of the work could be done more economically by teams and men than with machinery. Conversations with the engineers verified this opinion also.

Upon having the contract awarded to them, the contractors discussed the methods of doing the work. Large team outfits were put to work and a steam shovel installed in the steam shovel

cut. There was also a large cut under another steam road, and owing to the fact that a steam shovel could be installed there cheaply, it was decided to put one in this cut. This also gave the contractors a reserve outfit to help out the other shovel if it became necessary. In order to hasten the completion of the work, the contractors moved on the work three months ahead of the time stipulated in the contract in order to do the preliminary work and be in shape to push the job when good weather opened up in the spring.

After the contract was awarded and before the contractors went to work, the engineers of the railway company made a change in the alignment of the work for a distance of about 5 miles. The line was shifted from its position as laid on the ground when the contractors submitted their proposal, distances of 10 to 150 feet, crossing and recrossing the old line. This change affected the elevation of the center line but little, and had this been the only change, no doubt it would have been covered by the provisions of the contract and specifications that allow the engineer of the railway company to modify his plans so as to obtain the best results possible. But in addition to this change of alignment, the engineer made such decided changes in the grade line on the profile, stipulating new grades on these 5 miles, that it hardly had any resemblance to that upon which the contractors based their bids. This change threw out all waste and borrows, likewise overhaul on the material, and so materially affected the character of the work, that one of the contracting firms refused to stand by the tentative agreement as to the division of the work, stating that it was no longer the proposition upon which they had bid. Other arrangements were accordingly made, and the work was started.

After the work was commenced, no further changes were made in the alignment, but the engineer then began a rapid set of changes of the grade line on the profile. These changes affected very materially the cost of operation in carrying on the excavation, and reduced the income from the work that had to be done. All profitable excavation such as these contractors had bid upon on the profile that was an essential part of the agreement or contract, was thrown out. These changes were made over the entire contract.

The specifications made no mention of steam shovel work, except in the clause regarding overhaul, where it stated that this

clause did not apply to work done with steam shovels. The other clauses regarding gradation were similar to many other specifications.

From the information furnished to the contractors, they believed they were bidding on the construction of a railroad that was to be built by teams and men, and not by steam shovels. Otherwise they would have submitted a different proposal, except in one specific place where they were to use a steam shovel. The prices named were to cover this work according to the profile, plans and specifications.

It became evident to the contractors shortly after they began work that the engineers were acting in bad faith by taking advantage of technical points that were clearly not according to the intent and purpose of their contract. From letters and conversations which passed between the engineers and contractors, it appeared that the engineers discovered that by making certain changes in the grade line and in the distribution of material from the cuts they could instruct the contractors not to do certain work by teams, but to install steam shovels on the work and carry on the excavation in that manner. Thus payment for excavation of waste and borrow and for overhaul was evaded, and steam shovel prices were substituted, making the work more expensive to the contractor, and giving them less income. They took advantage of the clause in the contract that allows the engineer to direct the work as he sees fit; in other words, the engineers assumed the prerogative of deciding on the method the contractors should use in carrying out their contract. Without consultation with or the approval of the contractors, the railway engineers notified the contractors by letters that certain cuts on which there was overhaul or waste should not be done by teams, but that they should be considered and classified as steam shovel work.

It will be seen that the railroad company saved money by such a procedure, as illustrated by an example. A cut of 37,000 cubic yards which called for the entire excavation to be wasted, at the contractors' price for earth of 24 cents per cubic yard, would have given the contractors $8,880, netting them some profit. A mile from this cut there may have been an embankment that called for 37,000 cubic yards of borrow, which, if made from an adjoining borrow pit at the contractor's price for earth, would have given them $8,880, in which there would have been

a reasonable profit. This was the basis on which the contractors took the work, but the engineers would order a steam shovel to be put into the cut and the material carried a mile to the embankment, thus doing away with both the waste and borrow, and compelling the contractor to bring a shovel perhaps a mile to the cut and to excavate it at 35 cents per cubic yard, in addition to laying more than a mile of track from the cut to the embankment and hauling the material that distance. A temporary trestle would have to be built at the embankment and the shovel moved away when the cut was excavated. This method would give the contractor $12,950. The cost of this steam shovel work would exceed that of the team work, yet the contractors would receive $4,810 less for the work.

Again, with a cut of 37,000 cubic yards to be made by teams with the extreme haul on the material to be 3,000 feet, the contractors would have been paid at their price of 24 cents per cubic yard, with their additional price of 2½ cents per cubic yard per one hundred feet overhaul. But where such overhaul would occur, the engineers would eliminate it and order in a steam shovel, again reducing the amount of money that the contractors would receive for their work.

These things did not occur once or twice only, but in numerous instances. Cuts having only 9,000 cubic yards were ordered to be moved by a steam shovel in order to save overhaul, waste or borrow, when the shovel had to be moved nearly a mile to the cut. In many cuts, also, the contractors were required to haul the material in two directions with their steam shovel outfits, necessitating a mile or two of extra track laying and the construction of a second temporary trestle. At times, cuts a mile or two away from a shovel were ordered to be taken out by steam shovel, and the shovel moved there on the instructions of the engineer. When ordered to move a shovel to take out a few cuts, possibly 3 to 6 miles from an operating railroad, permission was refused to operate the shovel in adjoining cuts, which could be economically done while it was there, because there was no overhaul, waste or borrow, and therefore the engineers would pay for such cuts only under team prices. Thus ignoring the spirit of the contract, the engineers so changed the grades previously decided upon by the railway company as to throw out work that would have been profitable to the contractor and to sub-

stitute for it work of such a character that profits were not only eliminated but money losses were sustained in complying with instructions.

The railroad was located through a country, the surface of which is made up of red clay, highly colored from stains of iron. Underlying this clay is a much heavier pipe clay. The red clay has a fair amount of silica in it, allowing quick evaporation of water from it and also easy seepage through it; but the blue pipe clay readily absorbs and retains the moisture, and is water-soaked at all seasons of the year. Wells for drinking purposes sunk into these strata give an ample supply for ordinary purposes. These two strata of clay vary exceedingly in depth and overlie sandstone.

Evidently the engineers of the railway company made some tests for a classification of the material, as such a classification was listed on their profile. The contractors naturally were not able to make tests or borings to determine the materials which would be encountered in excavation. Their prices were based upon an inspection of the line and upon information furnished by the engineers.

It was found upon opening the work that during both summer and winter the pipe clay was so wet that it added greatly to the cost of the excavation. In conversations with the contractors, the engineers stated that they had not expected to encounter such conditions. To a great extent, the trouble was caused by the manner in which the grade line was established on the profile by the engineers. It would have been possible to arrange the grade line so as to take the greater part of the excavation out of the pipe clay and put it in the red clay, without greater cost to the railway company. Some changes made in the grade placed it deeper in the cuts, thus encountering the pipe clay, and the contractors were compelled to work all seasons of the year in mud and water. In winter the conditions were so bad that neither steam shovels nor teams could do much work.

Several injustices were done in regard to the purchase of land for borrowing and wasting material. The contract stated that such land must be furnished by the contractor, yet in one case where the railway company paid $50 per acre for land for the roadbed, an agreement was made with the property owner that any borrow pits needed on his land should be paid for at the rate of $100 per acre. But for this agreement the contractors

could have bought the land for a smaller consideration. The railway company added an extra price to the borrow pit and refused to compensate the contractors for it. This story speaks for itself.

The contract and specifications made provision and reserved to the engineers the power to make changes in plans and quantities of work to be done. This was considered by the contractors; but when contractors agree that alterations may be made in work under contract it must be understood that only such changes as may ordinarily arise on such work will be considered. It cannot be presumed, unless especially stated, that a contract can be annulled or changed so materially as to make the bid price inapplicable to the work.

Another clause stated that in all disputes regarding the work, plans or specifications, the engineer's decision must be final to the parties of the contract. There is little doubt that this clause was but the expression of the desire of both parties to avoid the complications of the law with which they were not familiar, preferring to rely on the decision of the practical and trained engineer. It is a fact that a broad minded engineer in charge of construction work can prevent law suits by careful analysis of all points of dispute and by rendering decisions based upon the merits of the case. But, inasmuch as the interest of the engineer is that of his employer, as a paid servant and agent he is prevented from acting as a referee and umpire, and there is nothing legally binding upon either of the parties of the contract in the engineer's decision. This is applicable to the case in question.

Many other injustices were done and set forth in this report, but enough has been given to show the harm that may be done to a contractor.

## II.

### *Onerous Specifications.*

Onerous specifications are a bugbear to contractors. The author feels that this book would not be complete without some comment upon the subject, so the following, from his personal experience, is given:

The specifications governed railroad construction. Under the heading of "Clearing and Grubbing," a clause reading "Grubbing

shall be paid for in the price paid for excavation," is so construed that in addition to the grubbing that must be done within the cross section stakes, the engineer may have grubbed any stump he may wish upon the right-of-way, and may order it moved entirely off the right-of-way. This is not always done, but the fact that it is sometimes done, throws an uncertain and extra expense upon the contractor. Grubbing, like clearing, should be paid for by the acre, and not included in the price of excavation.

Under some contracts, clearing and grubbing are paid for as one item. This sometimes works an injustice upon the owner, as it is quite easy to unbalance a bid, because of the fact that on most railroad construction there is a much larger acreage of clearing than of grubbing, the reason being that the entire right-of-way must be cleared, while only the area between the slope stakes must be grubbed. When each class of work is made a separate item, the contractor is paid for the work actually done. There is no worse way of paying for either clearing or grubbing than in the price for excavation, yet it is often done, not only in railroad construction, but also on reservoir work.

Grubbing varies exceedingly, hence the cost varies likewise. Naturally the cost per acre of grubbing the right-of-way of a railroad is much less than that for a reservoir. In addition, the cost of grubbing for a railroad will vary in itself according to the method of excavation. If the cut is breasted and shot with explosives, the stumps and roots are taken out as the excavation is made, and at a low cost. This is the method used when carts or cars are used or even steam shovels. When scrapers, especially wheelers, are used, the grubbing must be done before the excavation, hence at a greater cost. If an elevating grader is used, all the small roots must be grubbed and at a greatly increased cost.

In the specifications under the head of "Embankment," a clause states that wheelbarrows must not be used, nor must embankments be built by dumping from grade; the specifications providing that the embankment must be built in layers of such thickness as the engineer may direct. It is evident that in many cases such provisions are impractical, especially in rough mountainous country. In such places embankments are made in crossing deep ravines or on steep hillsides. Wheelbarrows are necessary to begin nearly all the cuts and embankments, and frequently on side-hill work where part of the roadbed is to be filled and part cut,

wheelbarrows and casting can be the only methods used. The author has seen work of this character where it was almost impossible to take a cart and mule on certain sections until the work was completed.

Dump carts and cars are used extensively in mountain work, and any other method would not only be impractical but extremely expensive. When steam shovels are used, and trains of cars serve them, the material is dumped by the cars from temporary trestles from grade. These specifications would thus prohibit the use of steam shovels.

It is evident that these specifications were meant to cover work done in open country with wheeled scrapers and wagons. Then it is not an injustice to the contractor to dump in layers, but many times works to his benefit, since it helps to equalize the haul. There is little doubt that an embankment built in layers by scrapers and cars is better compacted than one built by dumping from grade. Specifications for embankments should be written according to the prevailing practice of building them.

The work in question was located in the mountains, and for the majority of the embankments it was impossible to follow the specification. It is useless to say that these specifications were not enforced, although at one time it looked as though the chief engineer intended doing so, to the consternation of the contractors; but fortunately the work was taken up by a more experienced and practical engineer.

The clauses covering the classification of the excavated materials read as follows:

"Earth shall include loam, clay, sand, gravel, chert, cemented sand, indurated clay, joint clay, pipe clay, decomposed rock and slate, and all other material of an earthy kind. Earth shall also include loose stone or boulders, which do not exceed two (2) cubic feet in size, enclosed in masses of earth, wherein the proportion of boulders or loose stone is one-half or less.

"Loose rock shall include fire-clay shale, shale, slate, coal, soft friable sandstone, cemented gravel, or conglomerate rock; stratified limestone in layers of six (6) inches or less, separated by strata of clay; masses of boulders or detached rocks, free from earth, in which the average size of boulders or detached rocks is not less than one (1) cubic foot, nor more than one (1) cubic yard; and masses of earth mixed with loose stone and boulders of one

(1) cubic foot or more, average size, wherein the proportion of rock to the whole mass is more than one-half.

"Solid rock will include all rock in place, which rings under the hammer, in masses of more than one (1) cubic yard, with the exception of stratified limestone, described in the specifications for loose rock."

These specifications are very rigid, and to follow them closely means that exceptionally good prices must be obtained for the work. Similar work done for other railroad companies in the same section of the country, at the same prices, would net the contractor at least 15 per cent more money.

To class fire-clay shale as loose rock is an injustice to the contractor, since it is as hard as sandstone and as costly to work, until exposed to the weather. Anyone who has excavated chert knows that it is expensive enough to be classed as loose rock, unless it occurs in thin layers. Cemented sand and indurated clays are often known as hardpan, and although at times they may be excavated as cheaply as loam or clay, they usually cost much more.

The above two clauses, viz., the last under earth specifications and that at the end of the loose rock paragraph, are unusual, and although they are alluring to the contractor, they benefit him but little. Notice the difference in the size of the boulders, namely two cubic feet and one cubic foot. The conditions described are seldom met with, hence the engineer can make any allowance that he sees fit. For instance, a cut consisting of earth and boulders has been classified as 60 per cent loose rock, and under these clauses the contractor asks for the entire cut to be classed as loose rock. The engineer at once measures the size of the boulders, and as the average size is not found to be one cubic foot to one cubic yard, he rules that the cut is not loose rock, and it may be classified as earth if he so desires.

The stratified limestone in layers of six inches or less, separated by strata of clay, is another hardship. If the rock lies horizontally, and there are but a few veins of it, a heavy plow, with its point well under the strata, will break up the rock so it can be handled by scrapers or other simple means. But if the vein is on edge, and runs across the cut, or if the strata occur close together, the work is as expensive as solid rock.

The solid rock clause, "rings under the hammer," is one of the worst that has ever been inserted in specifications for excavation. "Rings under the hammer," is ambiguous, since it may mean two things. In drilling holes in rock with hand drills, almost any hard rock occurring in ledges will give a metallic ring as the hand hammer strikes the drill, and this ring will also be given out if the rock occurs in thin ledges with earth beneath. The author, in working under these specifications, took out some cuts of this kind, where a liberal classification of the rock could not give over 50 per cent of the cut, yet in drilling, a very much louder ring was given out as the drill was driven through the sandstone by the hammer, than in heavy ledges where the entire mass was solid rock. The earth under the thin ledges, two or three feet in depth, acted as a sounding board or box, giving out the distinct ring.

This, however, is not the "ring under the hammer" which is meant. If so, the contractor would get the better end of it. The ring referred to is in striking the rock with a hammer. One engineer, in classifying under these specifications, was accustomed to carry with him a small geological hammer to test the rock for this "ring." Anyone making this test will notice that many kinds of hard rock occurring in ledges will not give out a ring. Most fire made rocks, such as granite and gneiss, will do so, and some very dense sandstones also, but other sandstones, all slates, shale, mica schist and many other rocks will give only a dull thud under a hammer.

The result of this clause is to give the engineer unlimited sway in classifying solid rock. He makes an allowance of 50 per cent in a certain cut, where ledge rock has been excavated, and the contractor, after making some measurements, asks for 65 to 70 per cent. The engineer tests the rock with his hammer. The ring under the hammer is lacking. The engineer points out that it is thus shown that the material is not really solid rock, and that he has been exceedingly liberal in the classification.

This has been the author's experience under these specifications, and he knows of other contractors who have suffered. In one case, a well known contractor had his estimate cut $13,000 in one month by a re-classification under this hammer test.

In this same clause, the words, "all rock in place," can also

work a hardship on a contractor, but the most objectionable feature is the ring under the hammer.

A word as to slate. This material is as expensive to excavate as sandstone, unless it is disintegrated. When it is found in thick strata it must be drilled and blasted. The fine texture of slate quickly dulls the drill point, and excavation cannot be done for the ordinary loose rock prices.

In one paragraph the specifications provide:

"The prices bid per cubic yard for excavation will cover all expenses whatsoever connected with or incident to the work, and not otherwise provided for in these specifications or the annexed proposal."

Another paragraph reads:

"Cuts shall be neatly finished; the roadbed shall be surfaced smoothly to conform to the grades, and cross sections to be indicated by stakes to be set by the engineer; slopes shall be true and straight; side ditches shall be excavated to the depth and cross section required by the engineer."

A contractor bidding on such work for the first time would expect, when he was ready to dress up his work, to dig his ditches, bring his roadbed to grade and level it off. He finds entirely different conditions. Elaborate plans are furnished, showing how the roadbed is to be finished. Not even on tangents is the cross section of the roadbed made level, for the center is made one-tenth higher than the profile grade, and the sides of the roadbed one-tenth lower than the grade. On curves, the outside of the curve is given the necessary elevation, and the inside is cut down. Naturally, for each degree of curve, the cross section is different. Blue prints are furnished the contractor for this work and stakes are driven by the engineers to grade, and the work is supposed to be done within five-hundredths of a foot.

This method saves the railroad company a little money in ballasting, the track being laid with a track machine, but it adds very materially to the contractor's cost of dressing up the roadbed. In one such case, the contractor was allowed 6.6 cubic yards of earth on a 10-degree curve, per hundred feet of roadbed, for putting on this elevation. On lighter curves a proportional amount was allowed. For dressing up 6,300 lineal feet of roadbed, where the cuts were taken out a foot below grade and the embankments were up to grade or a little high and the slopes were all finished

as the excavation was made, the cost was $1,226.14. This made a cost of 0.97 cents per square yard, or 1.5 cents for each cubic yard of material excavated in the 6,300 feet. Dressing up work done in the customary manner in the same section of the country seldom costs ½ cent per square yard, averaging about ⅜ of a cent.

It is an injustice to make a contractor do such work under the clauses of the specifications quoted, since the cost in the case cited was one-tenth of the price paid for earth. The standard plans for this work could be shown to the contractor when he bids, and could be annexed to the contract and specifications as well as being mentioned in the clause describing the finishing of the road-bed.

There were other onerous, ambiguous and arbitrary clauses in the specifications in question, although in many respects they were fair and reasonable, especially in regard to tunnel work, but the last provision of the specifications read:

"Contractors must, in all cases, be governed by these specifications, and all promises made or orders given in conflict with these specifications shall not be considered binding."

This allows the chief engineer to revoke any rulings of his assistants, and even to change his own rulings if he so desires. This has been done frequently.

In considering these specifications further, the writer is fortunately able to give the opinion of the chief engineer of a piece of work let under them, relative to the appearance of clauses of the character here discussed. He says:

"I disagree with other writers, who state that such clauses add materially to the cost of work on account of bringing about a necessity for the contractor to 'bid a price about the factor of uncertainty.' But as a matter of fact these clauses are sized up at their true value by the experienced man, as he well knows they will not, as they ought not, hold before the courts of the land. I do not believe that the existence of these clauses in so many contracts can be justified on equitable grounds; but they are justified on the grounds of expediency. I have seen more than one obstreperous, irresponsible fellow held down to his business and made to do really good, honest work to his own eventual advantage, who would have given a great deal of trouble were it not for the fact that these clauses gave the engineers, seemingly at least, such absolute authority on the work. The engineer only makes use of

the unreasonable clauses to bring irresponsible men into line. I believe that as the contracting business develops and falls more and more into the hands of educated, competent and reliable men, we may see these clauses of doubtful equity disappear from construction contracts."

Has not the time asked for already come, and if these clauses are retained only to be held over the obstreperous or inexperienced contractor, could not the result be obtained without such clauses? One engineer may ignore such clauses, while another will follow them to the letter. Since the wild and woolly districts of our country have disappeared, business certainly can be carried on without such methods, and in a fair and equitable manner.

The views of the chief engineer who succeeded the one just quoted were expressed as follows:

"Every year a committee of our engineers revises our specifications. Every clause is there for a good purpose, and we have a good reason for inserting each clause. We reserve the right to vary from them when we see fit, and to enforce them when we have reason to enforce them."

This explains the last clause of the specifications quoted: "What is the reason?" and "when will they be enforced?" is the "factor of uncertainty," and from bitter experience the author knows that the wide awake contractor who wishes to make sure of his ledger showing a balance in his favor at the end of his job will do well to consider this factor.

Many contractors and engineers ask why is it that contractors, knowing that others have sustained losses under the specifications of certain railroads, are willing to do work for them. The answer is a simple one. The aviator knows that many men have been killed within the last few years in guiding airships, yet every day new aviators are coming before the public, and the misfortune of one does not deter another. There is always a new man to try it, believing that he possesses exceptional ability or luck that the others lacked.

## III.

### *Books for Contractors.*

Books are essential in every profession today, and there are many books on engineering and contracting subjects that should

be in the office of every contractor. All contractors, either general, special or sub-contractors, will find use for the following books:

*List No.* 1.

Frye's Civil Engineers' Pocket Book.
Trautwine's Civil Engineers' Pocket Book.
American Civil Engineers' Pocket Book.
Wait's Law of Contracts.
Wait's Engineering and Architectural Jurisprudence.
Johnson's Engineering Contracts and Specifications.
Wadell's and Wait's Specifications and Contracts.
Fowler's Law and Business of Engineering and Contracting.
Tucker's Contracts in Engineering.
Gillette's Handbook of Cost Data.
Taylor's Scientific Management.
Gillette's and Dana's Cost Keeping and Management of Men.
Gilbreth's Field System.
Gilbreth's Motion Studies.
McCullough's The Business of Contracting.
Practical Talks for Contractors.
Hauer's Economics of Contracting.
Rosenberger's Timekeeping System.
Bryant's Practical and Progressive Bookkeeping.
Johnson's Form of Account Books.

These books cover the broad field of engineering and contracting. They cover office work, the obtaining of contracts and the field work of carrying them on.

The first three books are hand books meant for engineers but containing many talks of use to contractors, and other data. Trautwine's book is so well known that comment upon it is not necessary. Frye's book and the American are both modern books, the former being written by one man and the latter by a number of authors, each producing one section of the book.

Wait's books deal with the legal side of contracts and are to be recommended to contractors; but books on legal matters cannot take the place of an attorney, although they may be the means of preventing a contractor from getting into legal troubles.

Johnson's book deals with forms of contracts and specifications. Wadell's and Wait's book is a small one meant for the use of students; but the young contractor will think it was also written for him. Fowler's book deals with the professions of engineering and contracting from an elementary, yet a practical standpoint.

Tucker's book discusses various phases of contracts in engineering work.

Gillette's *Cost Data* has had a large sale among engineers and contractors, and contains much on methods and costs. This book has done much to awaken interest in costs and to show their real value.

Taylor is known as the father of the idea of the management of men on a scientific basis. His book is written from his experience and contains directions for handling men and increasing their output. It is meant more for the mechanical field than for contracting, but the principles set forth apply also to contractors.

Gillette's and Dana's book gives forms and directions for cost keeping, and comments on the management of men.

Gilbreth's *Field System* is a collection of rules compiled under this well known contractor, to handle men on his jobs, scattered in several different states. Much can be learned from such a set of rules.

Gilbreth's book on motion studies shows the value of such work in saving useless motions, thus without great exertion on the part of the workman, producing greater results.

McCullough is a small book containing some excellent suggestions as to contracting. *Practical Talks for Contractors* is a similar but larger book.

Rosenberger's book gives a system of time keeping that prevents petty thieving from the contractor. The last two books in this list deal with details of office work, and can be used to improve methods of accounting.

Contractors having earth and rock excavating to do will find the following books useful in addition to those in List 1.

*List No. 2.*

Prelini's Earth and Rock Excavation
Gillette's Earthwork and Its Cost.
Gillette's Rock Excavation—Methods and Costs.
Dunham's Plat and Profile Book for Engineers and Contractors.
Henderson's Earthwork Talks.
Taylor's Prismoidal Formulae and Earthwork.
Trautwine's Excavation and Embankment.
Prelini's Dredging.
Stauffer's Modern Tunnel Practice.
Prelini's Treatise on Tunneling.
Druker on Tunnels and Explosives.
Richard's Compressed Air.
Hiscox' Compressed Air.

Prelini's book covers the subject of earth and rock excavating generally, but the greater part is devoted to transporting excavated materials.

Gillette's two books are devoted to methods and costs of earth and rock excavation. Dunham's book for contractors contains paper for plotting work and a number of useful tables. With this book, excavation can be plotted for record.

The three books on earthwork tables are meant for engineers; but for some purposes they can be used by contractors or their engineers.

Prelini's book on dredging is a new work and is given over to foreign and American practices.

The next three books mentioned are devoted to tunnel work. The first two were written within the past ten years, while Druker's is an older book, but is one of much value.

The two books on compressed air differ much from one another. Richard's is a theoretical book, while Hiscox', compiled to some extent from catalogs, contains much that is practical.

Contractors engaged in masonry and brick work will find these books given below valuable:

*List No. 3.*

Baker: A Treatise on Masonry Construction.
Biggin & Siebert: Modern Stone Cutting and Masonry.
Rice: Concrete Blocks, Their Manufacture and Use in Building Contracting.
Gilbreth's Bricklaying.

Baker's book on masonry is a standard work and hardly needs comment. Biggin and Siebert's book is a very good one on cutting stone for arches and other structures.

Rice's books on concrete blocks are considered the best on the subject. They cover the making, curing and use of the blocks.

Gilbreth's *Bricklaying* is the best work on this subject that has ever been published. It is not a treatise, but a well illustrated set of rules and instructions.

Most of the following list is meant more particularly for engineers engaged in railroad construction, but contractors will also find them useful in combination with lists 1, 2, 3 and 5.

*List No. 4.*

Wellington's Economic Theory of the Location of Railways.
Webb's Railroad Construction, Theory and Practice.
Berg's Buildings and Structures of American Railroads.
Foster's Treatise on Wooden Trestle Bridges
Camp's Notes on Track.
Tratman's Railway Track and Track Work
Lowell's Practical Switchwork.
Kindelan's Trackman's Helper.

Wellington's book is one of the greatest books ever written for the use of engineers, and it is so well written as to make it read like a novel. Written for engineers engaged in railway location, it covers the economics of construction, especially of railways. Every contractor will be benefited by reading it and having it for reference.

Webb's book is a small, practical volume, as useful to the contractor as the engineer.

Berg's book is a large treatise on railroad structural work, covering both designing and construction.

Foster's book on bridges is meant for engineers, but the contractor interested in wooden bridges will find it of service.

The next two books cover in an exhaustive manner American practices in track construction and maintainance. Since the contractor who lays track should know of the problems of maintainance and the latest practice, these books are invaluable.

Lowell's is a practical book on switch work, for the use of the track foreman.

Kindelan's is a book giving hints and information on track work. As contractor's roads are seldom kept in proper condition, this book should be a help.

So many books on concrete have appeared in recent years that it is possible to give only the leading books that may be of use to contractors:

*List No. 5.*

Buell and Hill: Reinforced Concrete.
Reid's Concrete and Reinforced Concrete Construction.
Gillette and Hill: Concrete Construction; Method and Costs.
McCullough's Reinforced Concrete; a Manual of Practice.
Taylor and Thompson's Concrete, Plain and Reinforced.
Godfrey's Concrete.
Sabin's Cement and Concrete.
Marsh and Dunn: Reinforced Concrete.
Rice's Concrete Block, the Manufacture and Use in Building Construction.

Baker's Cement Workers' Handbook.
Brown's Handbook for Cement Users.
Gilbreth's Concrete System.
Mörsch's Concrete Steel Construction.
Douglas' Practical Hints for Concrete Construction.
Reigler's Failures in Concrete Sidewalks and How to Correct Them.

Buell and Hill's book is written in two parts, the first for the designer and the second for the constructor.

Reid's book is a general one on the subject, meant to cover both the technical and practical sides. Gillette and Hill's book is devoted entirely to methods and costs. McCullough's work is a small, practical book especially devoted to the needs of the contractor.

Taylor and Thompson, Sabin, and Marsh and Dunn have all written books that cover the subject, both theory and practice, in a general way. All are good books and, although they are written mainly for the use of the engineer, the contractor will find them of value.

Godfrey's book is in a measure similar to these, though he puts forth many theories and ideas that differ from other authorities. However, some of his views have proven to be true and have already been accepted by engineers.

Rice's book has been commented upon. Baker's and Brown's books are both meant for practical helps to cement workers. They are small handbooks that can be carried in the pocket.

Gilbreth's *Concrete System* consists of a set of rules and a large number of photographs showing how the Gilbreth organization makes forms and mixes and places concrete.

Mörsch's book is a European work and although meant for engineers has in it information that is of use to contractors. The two last books are reprints of articles and their names plainly denote the subject covered.

The following list covers road and street work.

*List No. 6.*

Judson's City Roads and Pavements; Suited to Cities of Moderate Size.
Judson's Dust Preventives.
Byrne's Highway Construction.
Baker's Treatise on Roads and Pavements.
Gillette's Economics of Road Construction.
Gilmore's Roads, Streets and Pavements.
Spalding's Roads and Pavements.
Richardson's Modern Asphalt Pavement.

Ketchum's Highway Bridges.
Frost's The Art of Roadmaking.
Whinery's Specifications for Street Pavements.
Blanchard's Bituminous Roads and Pavements.
McCullough's Engineering Works for Towns and Cities.

This list, with lists Nos. 1, 2, and 5, will make a complete library for the contractor engaged in road and street work.

Judson's two books cover the subjects well. They are the only books adapted to the use of engineers and contractors, on these subjects.

Both Byrne's and Baker's books are large ones covering road and street work in a general way, that is useful to contractors.

Gillette's little book is devoted to costs and methods of wagon road construction. Gilmore's and Spalding's books, both written some years ago, describe various kinds of road and street pavements.

Richardson's book is a late one covering the subject of asphalt pavements, both in a theoretical and practical manner.

Ketchum's book is meant for the engineer designing bridges for highways, but the contractor will be glad to have such a book to refer to.

Frost's book is an excellent compilation on road building, giving information not only for the engineer, but also for the contractor. As it is a recent book, it contains much on modern practices in road construction.

Whinery's book is a small one, containing specifications only.

Blanchard's book is also a modern one, so that it has much to say on a subject of which both engineers and contractors know but little.

McCullough's book is meant for city officials, engineers and contractors and gives information not only on road and street work, but sewers, water works and other engineering features of towns and cities.

Contractors engaged in irrigation, levee and drainage work can use the following:

*List No. 7.*

Starling's Floods of the Mississippi.
Elliott's Practical Farm Drainage.
Elliott's Engineering for Land Drainage.
Wilson Irrigation Engineering.
Bowie's Practical Irrigation.

The names of these books indicate the subjects they cover. Though meant for engineers, they will also prove valuable to contractors. Combined with lists Nos. 1 and 2, this list will give the contractor all in print on these subjects.

Contractors on sewer work will find the following books of value:

*List No. 8.*

Folwell's Sewerage Systems, Designing, Construction and Maintenance.
McCullough's Engineering Works for Towns and Cities.
Ogden's Sewer Construction.
Raikes' Sewage Disposal.
Swaab's Tables and Diagrams for Making Estimates for Sewer Work.

Folwell's book is the standard work on sewers and a contractor doing sewer work should have it for reference. McCullough's book has already been mentioned. Ogden's book on sewers first takes up the design of sewers, and then gives much cost data on sewer construction.

Raikes' book was written for engineers, but it will be found of value to contractors.

Swaab's is a small book, from which estimates of costs can be made for sewer work.

Books on building and building construction, and also on features of building such as ventilation, plumbing, lighting, heating, carpenter and steel work, fireproofing, waterproofing and other details, are many. Those mentioned are standard ones and cover this class of construction in a general way.

*List No. 9.*

Kidder's Architects' and Builders' Pocket Book.
Kidder's Building Construction and Superintendence (3 Vols.).
Arthur's Building Estimator.
Richey's A Handbook for Superintendents of Construction, Architects, Builders and Building Inspectors.
Richey's Building Foreman's Pocket Book.
Hicks' Builders' Guide.
Hicks' Estimators' Price Book and Pocket Companion.
Farrar's Specifications for Building Works.
Davis' Quantities and Quantity Taking.
Merrill's Stone for Building and Decoration.
Lewis' Methods of Waterproofing.

This list, together with Nos. 1, 2, 3, 5 and 10, will furnish the books needed by the building contractor.

Kidder's Pocketbook is too well known to need comment. Every building contractor should have one. Kidder's three volumes on building construction is a monumental work. The first volume is devoted to masonry, the second to carpentry and the third to roofs.

Arthur's book, when first written, was meant for use in his home town of Omaha, Nebraska, but with successive editions, it has been enlarged and it now is an estimating book, meant to cover work in all parts of the country. It has much space devoted to methods and costs.

Richey's books are practical ones, meant more for the constructor than for either the architect or the engineer. They contain much information for every day use.

Hicks' books are also practical ones, meant for the man working from plans.

Farrar's book is one on specifications only. The important subject of taking off quantities of work to be done on buildings is covered in Davis' book. Nothing can be more important to contractors than this.

Merrill's book on stones is a useful one. It gives the geological classification of stones, the characteristics of the stone for building or decorating and the methods of dressing stones.

Lewis' book is the best that has been produced concerning waterproofing—a subject of which both engineers and contractors know too little.

For foundation work, the following books will be useful.

*List No.* 10.

Patton's A Practical Treatise on Foundations.
Richard's Compressed Air.
Hiscox' Compressed Air.
Fowler's Ordinary Foundation.
Wegman's Design and Construction of Dams.
Corthell's Allowable Pressures on Deep Foundations.

Comments have been made on the two books on compressed air. Patton's and Fowler's books will be found useful to the contractor as well as the engineer.

Wegman's book has an excellent chapter on cofferdam work, which will be found of great value to contractors.

Corthell's book is a compilation of allowable pressures on deep foundations and is of value as a reference book.

The following is a list of books for constructors of dams (both earth and masonry):

*List No.* 11.

Wegman's Design and Construction of Dams.
Schuyler's Reservoirs.
Bassell's Earth Dams.

Wegman's book was originally meant for engineers but the author has lately revised it and added much that is of use to contractors. It is the standard book on dams.

Schuyler's Reservoirs is a book describing especially methods of building earth and rock filled reservoirs. It is meant as much for the contractor as the engineer.

Bassell's little book describes one particular earth dam, giving methods and costs. The author has added considerable data on earth dams, making the book of use to contractors.

Every contractor needs at times to refer to some mechanical handbook for information concerning machinery and materials. For this purpose he will find the following books convenient. The first named is a small handbook into which is crowded much valuable information in a concise form. The second is a large book in which subjects are treated at greater length.

*List No.* 12.

Sames' Mechanical Handbook.
Kent's Mechanical Engineers' Pocket Book.

For telephone, transmission lines, conduit and cable work, the following book gives much data:

*List No.* 13.

Meyer's Telephone Construction, Methods and Cost.

This book also treats of methods and costs of trench work, which are applicable to sewer construction and water pipe work.

*List No.* 14.

Foster's Electrical Engineers' Pocket Book.

This is a valuable reference book on electricity and its uses.

*List No.* 15.

Reimer-Corning-Peele on Shaft Sinking Under Difficult Conditions.
Donaldson's Practical Shaft Sinking.

The first book discusses a difficult class of work very well, but unfortunately is mostly descriptive of foreign work.

Donaldson's *Practical Shaft Sinking,* however, is a book written by a man who has done much shaft work, and the book is to a great extent practical, rather than theoretical. The need of such a book is emphasized by the fact that more work of this character is now being done than ever before, not only in construction work, but also in mining.

These lists are not complete, but they will no doubt prove of some value to busy contractors.